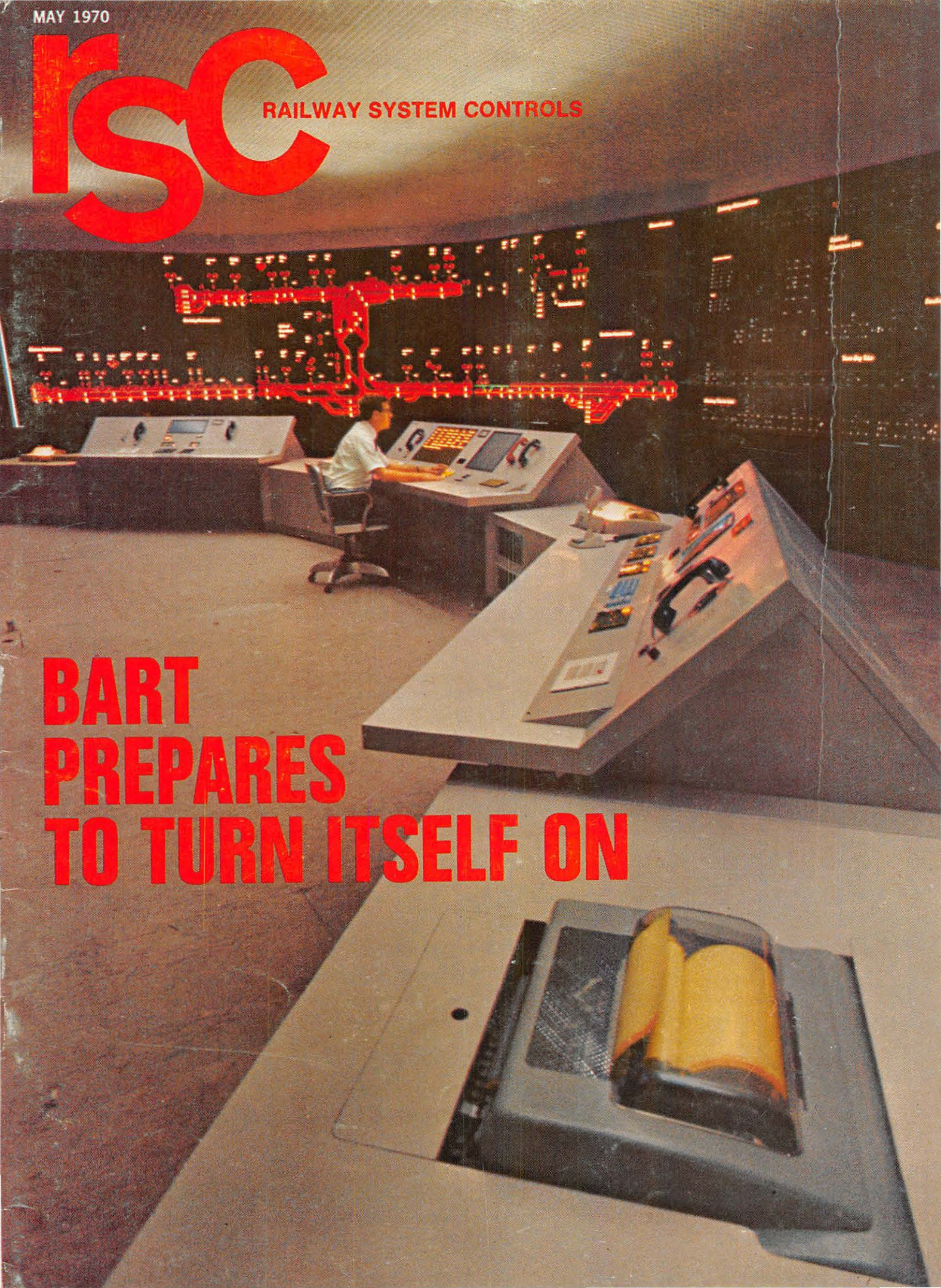
MAY 1970

rsc

RAILWAY SYSTEM CONTROLS

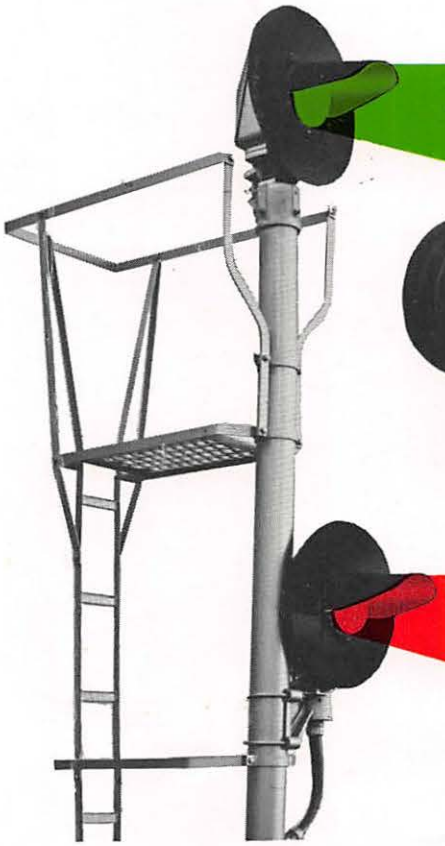


BART PREPARES TO TURN ITSELF ON

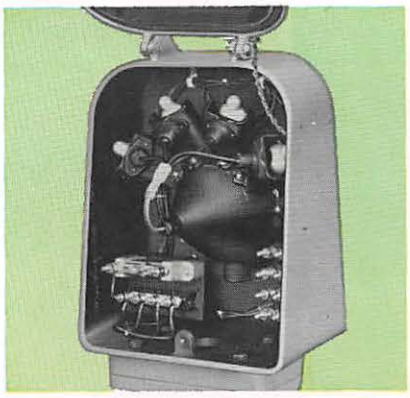
PROGRESS REPORT NO. 1

RACO® UNILENS®

COLORLIGHT SIGNALS

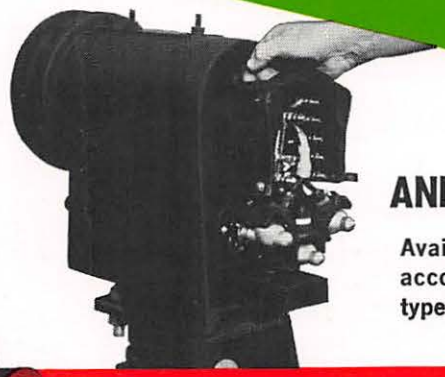


All aluminum construction — available for Mast, Bridge or Bracket signal. Top or side of mast mounting. Also available for dwarf signal.



Interior view of light source and fibre optic system.

FOR TOTALLY NEW SYSTEMS . . .



AND CONVERSION UNITS

Available in seven variations to accommodate both stepped lens type or compound lens type.

26 RAILROADS

have recognized the economies and advantages of the RACO UNILENS for new systems as well as conversion units when replacing multi-lens colorlight, semaphores and searchlight type signals.

UNILENS has no mechanism. The unique single lens color indication system eliminates the need for moving parts, repeating relays, associated circuitry and requires only minor circuit change when UNILENS conversion units are installed.

UNILENS utilizes 75% of the lamp output compared to 30% in colorlight signals of yesterday . . . thanks to a more efficient sealed beam light source and advanced design.

UNILENS provides a better signal at less cost . . . to buy . . . to install . . . and to maintain than any other type of wayside signal.

MEMBER RPI RAILWAY PROGRESS INSTITUTE

For complete details, contact:

OUR 50TH YEAR

RACO PRODUCTS ENGINEERED FOR LONG LIFE ®

Railroad Accessories Corporation

A CCI INDUSTRY

Main Office and Plant: 4650 MAIN STREET N.E., MINNEAPOLIS, MINN. 55421

Office and Plant: 7615 NATIONAL TURNPIKE, FAIRDALE, KY. 40118

REPRESENTATIVES: Southeastern Railroad Materials Inc., 595 North Avenue N.W., Atlanta, Ga. 30318
Long Supply Co., 1720 Algonquin Road, Mt. Prospect, Illinois 60056
IN CANADA: Vale Enterprises, Ltd., 1120 Claire Crescent, Lachine, Quebec
OVERSEAS: International Markets, Inc., 60 East 42nd Street, New York, N.Y. 10017

Circle 1 on reader service card

FROM
CANADIAN MARCONI COMPANY
A NEW CONCEPT
IN TELECOMMUNICATIONS

ONLY $300 (OR LESS) PER CHANNEL-END INCLUDING ALL COMMON AND LINE-INTERFACE EQUIPMENT

Canadian Marconi Company with their MCS 6900 PCM microwave communication system has dramatically reduced the cost of telecommunications systems and, at the same time, has significantly increased application flexibility and reliability.

In the MCS 6900 the use of common equipment has been radically changed. All functions required to pulse code modulate input audio to Bell T1 performance standards and to demodulate incoming PCM signals are performed by a single module, the channel unit. In addition, each channel unit contains A/D and D/A conversion circuits, and telephone line interface and signalling circuit sub-modules.

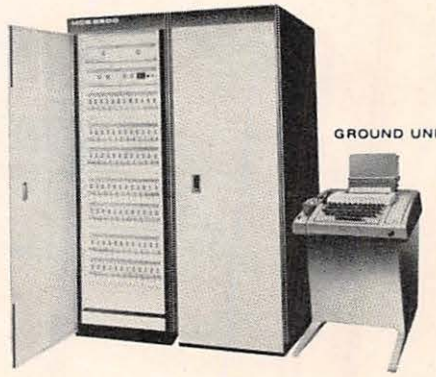
The result -- you add a *complete* voice channel whenever you want, simply by inserting channel units at less than 50% the cost required for comparable systems.

Use of identical rather than common circuitry also increases reliability by a quantum step -- the danger of losing a block of channels, as is possible with other PCM or FDM systems, is negligible with the MCS 6900.

Developed from field proved military equipment, the MCS 6900 will provide you with all the advantages, and more, of other existing systems --- *and at a fraction of their cost.*

Write today for complete information to the Telecommunications Division, Canadian Marconi Company, 2442 Trenton Ave., Montreal 301, Quebec, Canada or call 514 - 343-3411.

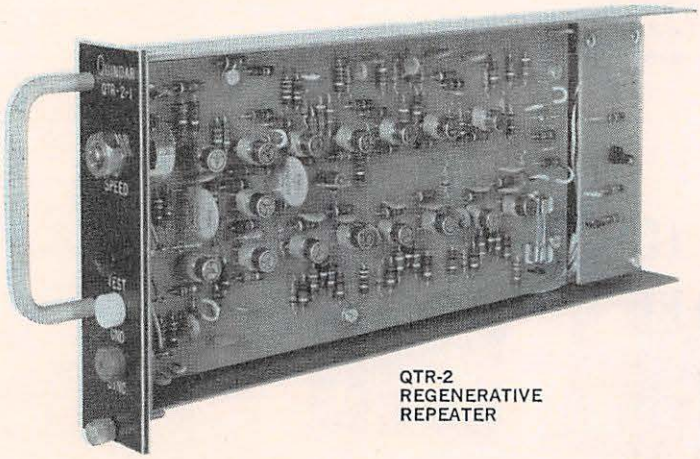
MASTHEAD UNIT



GROUND UNIT

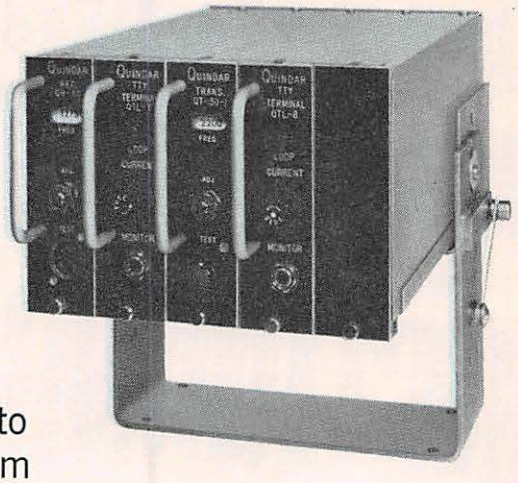
CANADIAN MARCONI COMPANY
TELECOMMUNICATIONS DIVISION

Circle 4 on reader service card



QTR-2
REGENERATIVE
REPEATER

QTTY-130FD
TELETYPEWRITER
SUBSET



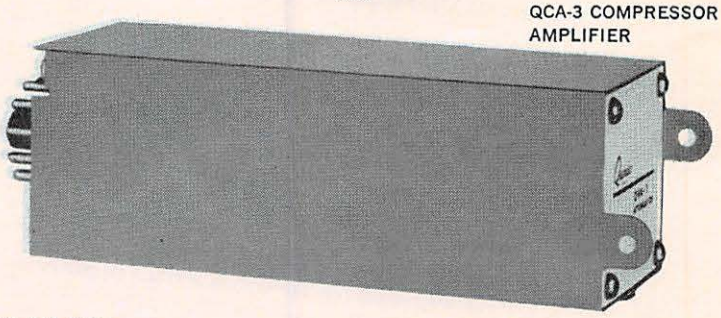
Low cost, off the shelf railway communications equipment . . . from line and compression amplifiers to regenerative repeaters — from strappable attenuators to TTY subsets . . . can optimize modification or expansion of present communications networks, can modernize installation when updating an existing system.

QVA-1 ATTENUATOR

QRB-2 RESISTANCE
BRIDGE

QLA-SERIES LINE
AMPLIFIERS

QCA-3 COMPRESSOR
AMPLIFIER



Quindar
ELECTRONICS, INC.

QUINDAR ELECTRONICS, INC., 60 FADEM RD., SPRINGFIELD, N.J. 07081
(201) 379-7400
Offices in principal cities throughout the United States,
Canada and Europe.

Circle 5 on reader service card

MAY 1970 VOL. 1 NO. 2

RSC RAILWAY SYSTEM CONTROLS

FEATURED THIS MONTH:

BART controls begin "dry run" testing period 13

Transit gets automatic train stopping 18

Signal systems may change with electrification 21

SP gets fast information retrieval via TV film 24

How to TV and retrieve a waybill 26

Third generation computers help Southern 27

Southern management involved in computer usage 30

DEPARTMENTS:

Data Sheet 187: Data Modem Characteristics 34

Editor's Corner: Data pollution is here 42

News Briefs 11

People 38

Product News 31

Published monthly by Simmons-Boardman Publishing Corporation, 508 Birch St., Bristol, Conn. 06010, with executive office at 30 Church St., New York, N.Y. 10007. Second class postage paid at Bristol, Conn. 06010 and at additional mailing offices.

Member of the Audit Bureau of Circulations (A.B.C.) Name registered in U.S. Patent Office. Printed in U.S.A. by the Johnson Press, Inc., 800 North Court St., Pontiac, Ill. 61764.

© 1970 Simmons-Boardman Publishing Corporation

Member of RPI Railway Progress Institute

Audited Paid Circulation ABC

Subscriptions: Address all subscriptions and correspondence concerning them to: Circulation Department, Railway System Controls, P.O. Box 530, Bristol, Conn. 06010. Change of address should reach us three weeks in advance of the next issue date. Send old address with the new, enclosing if possible your address label. The Post Office will not forward copies unless you provide extra postage. Duplicate copies cannot be sent.

Subscription price to railroad employees only in U.S., Possessions, Canada and Mexico, $3.00 one year, $5.00 two years. All others $6.00 one year, $9.00 two years. Payable in advance and postage free. All other countries: $8.00 one year, $16.00 two years. Single copies 75¢.

POSTMASTER SEND FORM 3579 TO P.O. BOX 530, BRISTOL, CONN. 06010.

Editorial Office
29 E. Madison St., Chicago, Ill. 60602

Robert W. McKnight, Editor

Mrs. Grace Rempert, Editorial Assistant

Executive Office
30 Church St., New York, N.Y. 10007

Robert G. Lewis, Publisher

Fred B. Hecht, Production Manager

Maurice H. Mates, Art Director

John E. Rogers, Director of Circulation

Constance Nicolai,
Manager of Contracts

ADVERTISING SALES:

New York, N.Y. 10007, 30 Church St., Phone: 212-964-3060. W. Arthur Cubbage, Regional Sales Manager; Charles E. Keil, Regional Sales Manager.

Chicago, Ill. 60602, 29 E. Madison St., Phone: 312-641-5815. C. James Fisher, Vice-President Sales; Kerry F. Sheeran, Regional Vice-President; John M. Brennan, Regional Sales Manager.

Pittsburgh, Pa. 15219, 1230 Frick Building, 437 Grant St., Phone: 412-471-7871. Ronald M. Giallonardo, Regional Sales Manager.

Dallas, Tex. 75206, Noel Page Building, 6400 North Central Expressway, Phone: 214-361-6972. Joe Sanders, Joe Sanders & Associates.

Los Angeles, Cal. 90025, 11704 Wilshire Blvd., Phone: 213-477-4004. Fred Klaner, Jr.; Philip O. Bowers, The Klaner Co.

San Francisco, Cal. 94133, 515 Pacific Ave., Phone: 415-421-7004. Lewis A. Vogler, Lewis A. Vogler & Co.

London, S.W.1, England, 67/68 Jermyn St., St. James's, Phone: 01-839-6318. Max F. Holsinger; Peter Clifton; Alan Berg.

Manchester 22, England, Haletop, Wythenshawe Civic Center, Phone: 061-437-3293. Ian Goulden.

Paris 8e, France, 70 Rue de Ponthieu, Phone: 359-65-77. Stephen Brown-Joussard.

4 Dusseldorf-Rath, Eitelstrasse 32, 632031. Max F. Holsinger; E. Hillerbrand; Herbert Haibt; Reinhard Schomburg.

Tokyo, Japan, Sun Gain Shia, Ltd., Shiba Nikkatsu Bldg., 13, Shiba Park, Minato-Ku. C. H. Yiu, Managing Director.

When you're connecting voice, data, or other signals to microwave radio, the right multiplex makes all the difference between a perfect and an imperfect union.

That's true for short-haul or long-haul, low-density or high-density applications. And that's why we offer the broadest multiplex line of any manufacturer.

In fact, we're the only manufacturer that makes multiplex equipment for every application.

Take our unique 46A, for example. You can buy one channel or 1260 channels. Or anything in between. The 46A maintains toll-quality performance on systems thousands of miles long. And you can assign data circuits indiscriminately without sacrificing voice service on any other channel.

Then there's the 24-channel 34A for light routes. And the AN/UCC-4(V) for military systems of 12 to 600 fully loaded voice or data channels.

And the 47A Radio Multiplex to transfer up to 144 channels from cable to radio and back again. Directly. So there's no need for back-to-back channelizing equipment.

In fact, we make just about everything you need for a complete communications system. Multiplex, microwave, cable carrier, data modems, and accessories.

If you want us to, we'll also install and check out the system, train your personnel, and provide back-up support for the life of the equipment.

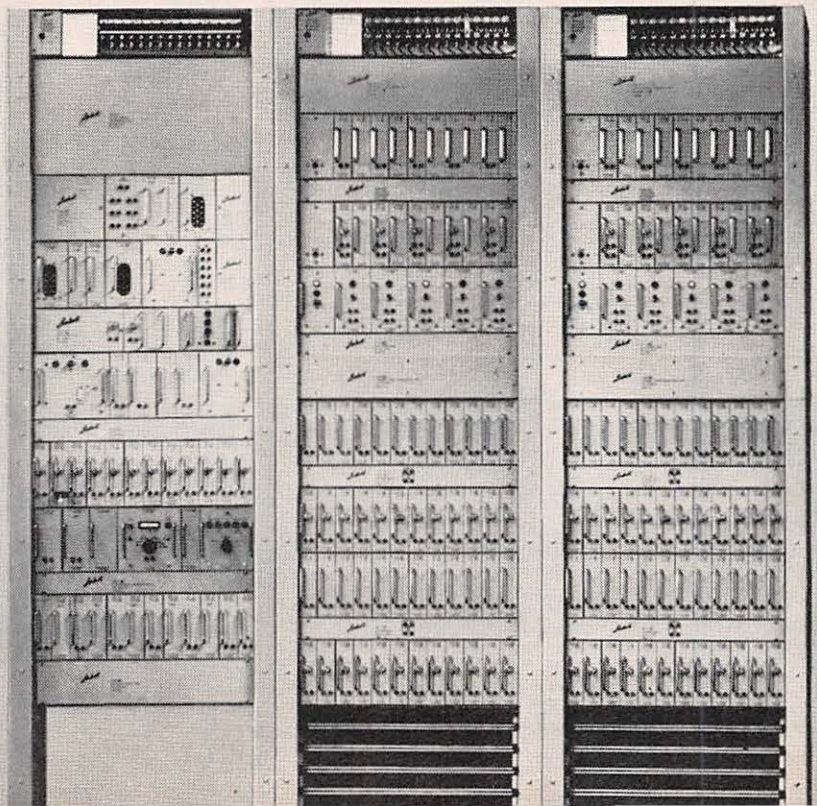
That completes the perfect union.

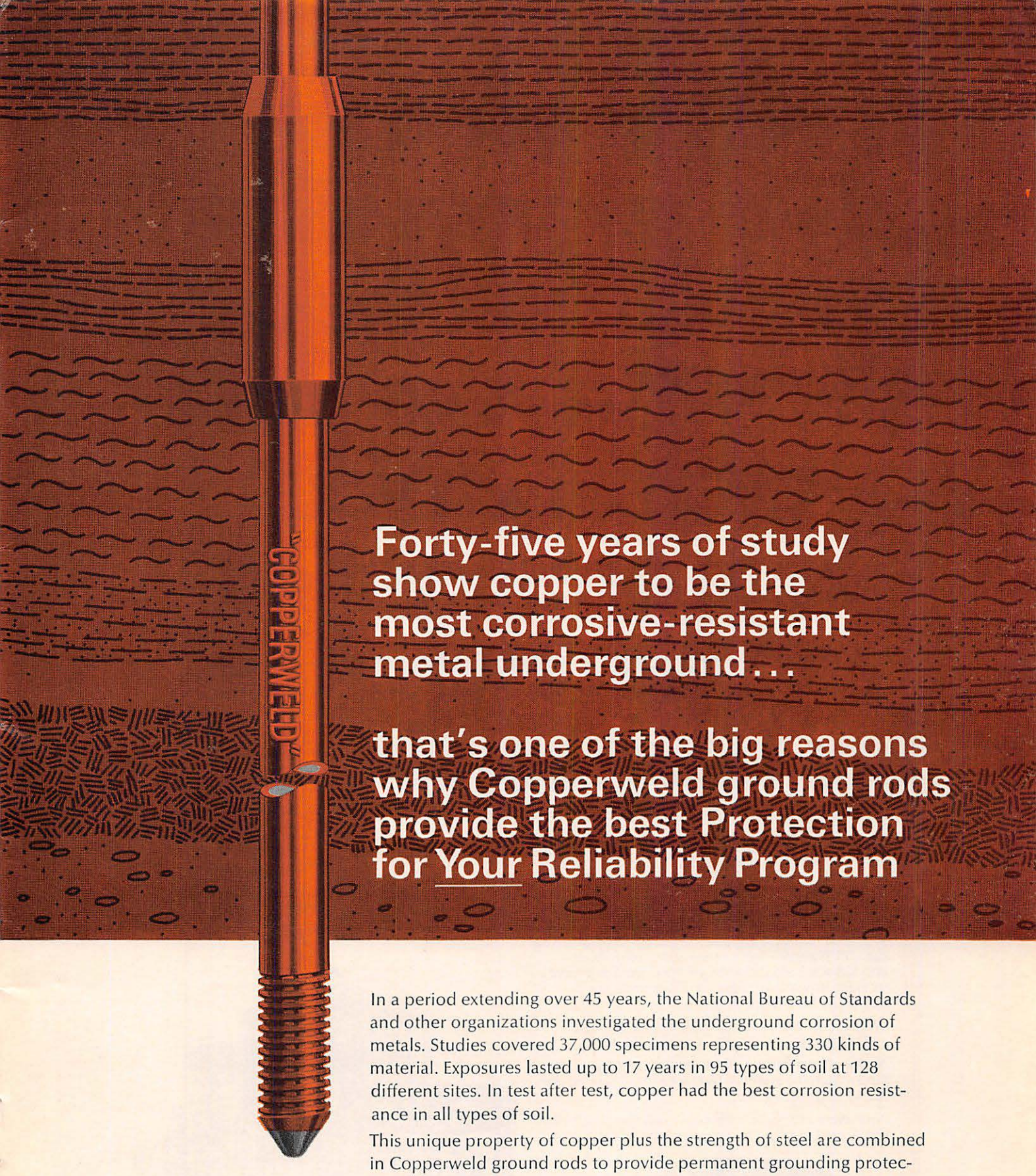
LENKURT ELECTRIC
GENERAL TELEPHONE & ELECTRONICS

Lenkurt Electric Co., Inc., San Carlos, California.

Multiplex Equipment from Lenkurt

In order to form a more perfect union.





Forty-five years of study show copper to be the most corrosive-resistant metal underground...

that's one of the big reasons why Copperweld ground rods provide the best Protection for Your Reliability Program

In a period extending over 45 years, the National Bureau of Standards and other organizations investigated the underground corrosion of metals. Studies covered 37,000 specimens representing 330 kinds of material. Exposures lasted up to 17 years in 95 types of soil at 128 different sites. In test after test, copper had the best corrosion resistance in all types of soil.

This unique property of copper plus the strength of steel are combined in Copperweld ground rods to provide permanent grounding protection unequaled by any other rod. Made under strict quality controls by the company that has pioneered major engineering advances in grounding techniques and products, Copperweld ground rods are today, as they have been for almost 50 years, the standard of excellence.

Copperweld® ground rods

STOCKED AND SOLD BY LEADING DISTRIBUTORS

World Leader In Bimetallic Wire

COPPERWELD STEEL COMPANY

WIRE AND CABLE DIVISION, GLASSPORT, PA. 15045

For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, New York

SPECIALTY MATERIALS

Circle 7 on reader service card

What good are clean ash trays when you can't get the car the ash trays come in even when you have a reservation and the reservation has been confirmed?

For a long time now, there's been so little difference between car rental companies they argued publicly about who had the cleanest ash trays. Max has changed all that.

Max is National Car's computer. He knows from minute to minute which of our cars are available.

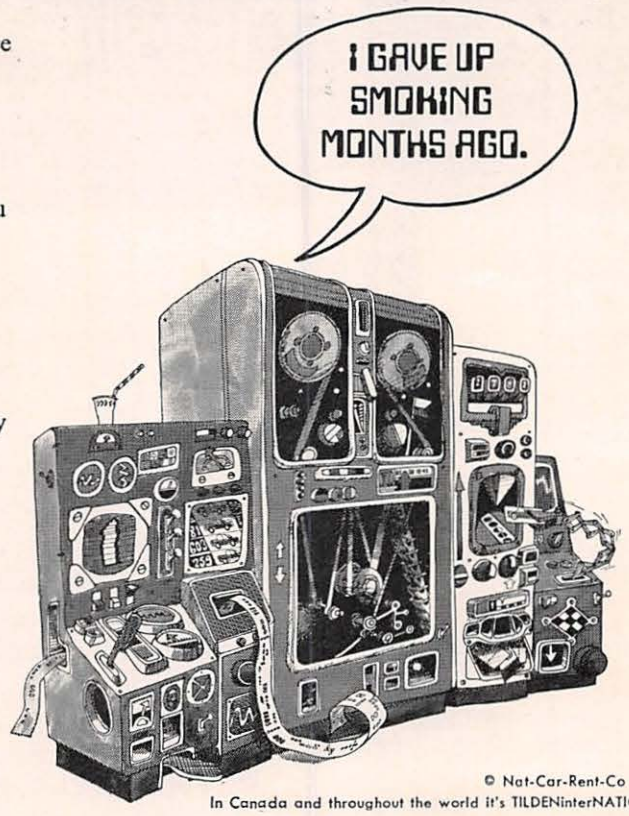
Wherever you are, anytime of the day or night, you can call National for a reservation toll-free at 800-328-4567. And thanks to Max, we don't have to make any assumptions or blind promises like those New York outfits do.

We just ask Max what's available, Max tells us, and we can guarantee you a car on the spot.

National also features GM cars, gives S&H Green Stamps, and has 1800 locations. Second only to old what's-its-name.

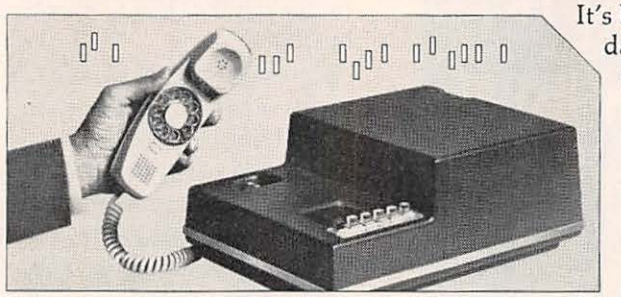
Now *there* are some differences you can sink your credit card into—any recognized credit card.

We make the customer No. 1



© Nat-Car-Rent-Co 1969
In Canada and throughout the world it's TILDENinterNATIONAL

HOW TO DOUBLETALK A COMPUTER



It's Lynch's latest solid state data set, available only through Graybar. It allows alternate voice and data communication between telephone stations in the DDD network, and over private or leased lines. Provides voice band, full duplex transmission between customer-owned business machines and data processing equipment... at speeds up to 1800 bits a second.

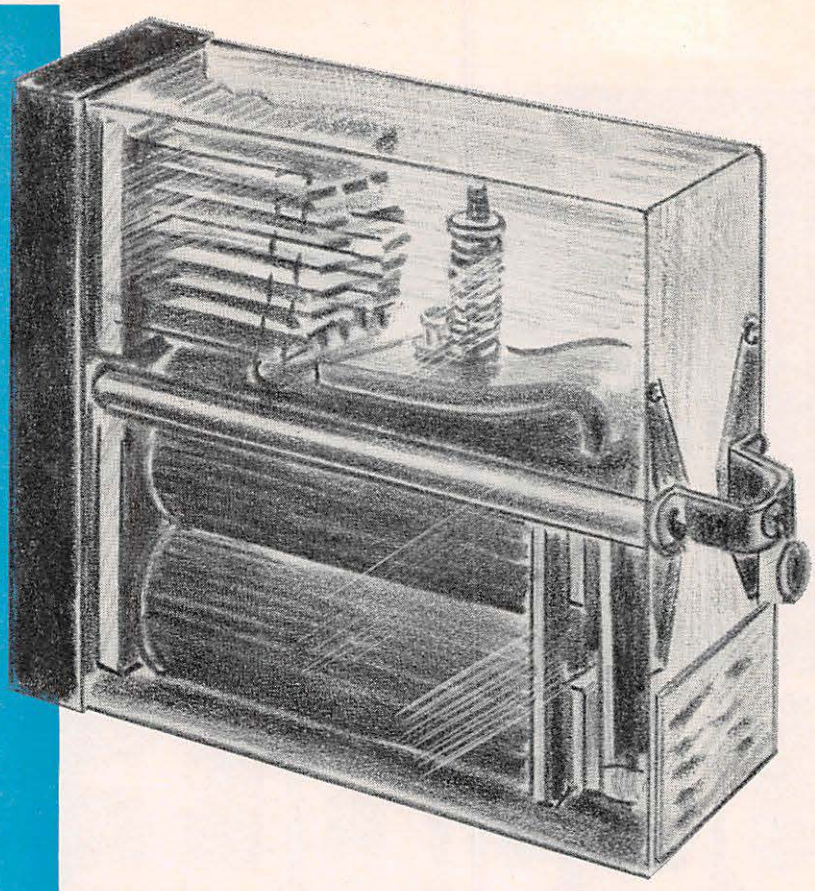
The L2202C is fully compatible with W.E.'s 202C Data Set—even the plugs are interchangeable. (Identical test procedures too.) It meets EIA standard RS-232B interface between business machine and data set. Plug-in printed-circuit modules make it easy to service.

This is another in a series of Lynch data sets available through Graybar. (The first introduced models compatible with W.E. 103A and 103F sets.) The entire series is just one more example of how you can depend on Graybar for the newest developments in communications equipment, and for fast, dependable service in over 150 cities. We'll welcome your inquiry.

Go to the source: Graybar.

Circle 8 on reader service card

NEUTRAL
MAGNETIC-STICK
VANE
LAMP CONTROL
POLARIZED
POLAR-BIASED
FLASHER
CODE-RESPONSIVE
TIMING
REGULAR-RELEASE
SLOW-PICKUP
SLOW-RELEASE
POWER-TRANSFER
LIGHT-OUT NEUTRAL
SWITCH-OVERLOAD
BIASED-NEUTRAL
QUICK-PICKUP
RETAINED-NEUTRAL
SWITCH-CONTROL



VARIETY

is the word for Type B relays

The GRS catalog lists more than 150 different Type B relays – one to fit every signaling requirement.

When you specify Type B relays, you can rest assured that you will get the best vital circuit relays available, each precisely fitted for the specific circuit task you want done. And you get these benefits too:

- SIMPLIFIED CIRCUITING – large contact capacity makes your circuit designers' jobs easier, makes plans more straightforward and simpler to follow
- ADDED SAFETY – built-in registration protects against plugging in any but the right relay.
- SIMPLIFIED INSPECTION AND TESTS – because all Type B's are quick-detachable, plug-in units.
- DEPENDABILITY – proved over the years by the thousands of B relays serving railways and rail rapid transit systems throughout the world.

We also offer a variety of Type K relays, wall or shelf mounting, for those who prefer binding-post style relays.

GRS is a full-line supplier of signaling equipment, from electric switch machines (13 types) to dragging equipment detectors, for example. You name it - we have it if it's for railway – or rapid transit – signaling.

GENERAL RAILWAY SIGNAL COMPANY
A UNIT OF GENERAL SIGNAL CORPORATION
ROCHESTER NEW YORK 14602
3507

ATLANTA BOSTON CHICAGO MONTREAL NEW YORK OAKLAND ST LOUIS ST PAUL

Circle 9 on reader service card

Railway System Controls

"is most useful to us," say readers because it provides outstanding coverage and excellent technical reporting of the fast-paced changes taking place in the field of railroad communications, signaling, computer usage, and system controls. It is important that those charged with responsibility for these vital operations be fully and currently informed of new developments in that area. If you are a reader—and not a subscriber—fill out the card today and mail it.

Subscription Order Form

Please enter my subscription to

RAILWAY SYSTEM CONTROLS

☐ for two years—$5
☐ for one year—$3

☐ Payment enclosed.
☐ Bill me.
☐ Bill my company.

☐ New Subscription.
☐ Renewal.

NAME .....

☐ BUSINESS
☐ HOME
ADDRESS .....

CITY ..... STATE ..... ZIP .....

RAILROAD .....

DEPARTMENT ..... TITLE .....

Above rates apply only to railroad men in U. S. & possessions, Canada & Mexico
Foreign and Non-Industry rates furnished on request

Reader Service Card

Help yourself to a personal subscription to Railway System Controls every month. Have your own copy to read at home or in your office. Keep up with the other fellow by receiving your copy when he does. Just fill out the other side of the card below, tear it out, and drop in a mailbox.

No Postage Stamp Necessary If Mailed in the United States

Postage Will be Paid by Addressee

BUSINESS REPLY MAIL

First Class Permit No. 153, New York, N.Y. 10007

RAILWAY SYSTEM CONTROLS

P.O. Box 530

Bristol, Conn. 06010

News Briefs

Mass transit extends computer applications

The growing use of computers by mass transportation systems of the nation's major cities was spotlighted by David Q. Gaul, executive secretary of the Institute for Rapid Transit. Gaul addressed the February convention on aerospace and electronics systems held in Los Angeles by the Institute of Electrical and Electronic Engineers.

Mr. Gaul is now operating engineer, Washington Metropolitan Transit Authority.

"Computers are being applied more and more in three general phases of our transit industry," Gaul said.

"First, there is the use of computers by transit operators for business procedures such as payrolls, accounting, inventory control, and budget control," he explained.

"Secondly, there is the application of computers in the operational and engineering aspects of our industry. And then there is also the use of computers in the scheduling and planning functions of the transit industry."

Gaul reported that "much progress" has been made by transit operators in the use of computers for payrolls, accounting and other business procedures, with "practically all of our large transit systems throughout the country having adopted computers for these purposes."

Much of the transit industry's effort, Gaul explained, now is being directed primarily to the use of computers in engineering and operations.

"For example, in former days, the determinations of speed time and power consumption curves were all done laboriously by manual calculations," he said.

"The adaptation now of computers for this function not only has reduced the calculation time," Gaul noted, "but more importantly it has permitted a much more extensive analysis of the effects of operating performances—that is, acceleration, top speed, deceleration—in relationship to the time saved versus power consumption.

"As to the third phase—that of using computers in the scheduling and planning functions of the transit industry—there is confidence that success is right around the corner. This is especially important because it could result in substantial savings."

The following examples were cited by Gaul of how the transit industry is turning to computers:

Chicago Transit Authority, the second largest transit agency in the country, has a General Electric 415 computer that has been in use since May, 1966. When the CTA was organized and was operating on an old accounting basis, there were 312 persons in the accounting department. The use of new tabulating systems and, more recently, by the use of the computer has reduced the staff by two-thirds.

Besides financial reporting, another major area of application of the computer is inventory control. The CTA has some 80,000 items in its store rooms, and formerly had 13 persons sorting and posting inventory activity on bookkeeping machines. Now, with the computer for inventory control work, the CTA has cut the former staff of 13 persons to only four persons. Furthermore, the computer tells when to order materials and how much to order, all of which is based on previous usage.

With the computer on inventory control, the CTA is also able to measure the performance of suppliers. Is a supplier delivering on time or is a supplier falling down on his delivery dates? Every four weeks there is a master stock status report on all items which shows what and how many items are on hand and how much is on order. It is also important to note that the stock status report also shows the usage trend.

CTA has also found the computer to be particularly helpful in phasing outmoded rapid transit car or bus fleets. In these cases, the computer is used for a printout of all parts pertaining to each type of car or bus in the fleet, which permits a systematic reduction in the ordering of parts for those vehicles to be phased out of service.

As would be expected, the CTA uses its computer for processing payrolls. As by-product benefit, on the payroll work, the CTA management gets more meaningful reports. For example, overtime costs can be pinpointed, which has permitted the management in a number of instances to take corrective measures to avoid such excessive costs.

Another area in which the Chicago Transit Authority uses its computer is for compiling data on rolling stock. For example, the CTA uses the computer to keep track of the number of miles each bus is operated. It also keeps constant track of the miles per gallon of fuel, the number of miles since the last engine overhaul and since various equipment replacements were made, such as the changing of tires, axles, etc. Also on buses the computer is used for keeping up to date on the causes of bus failures —Why the breakdown occurred, what failed, and how many and how often a particular failure occurs. Also, who was driving when the failure occured and whether it was an operator or equipment failure. The CTA computer also analizes vehicle operations by car, house or garage.

CTA has also made progress in applying the computer in the operational and engineering aspects. For example, the engineering department made use of the computer for the positioning of block signals on the recently opened Dan Ryan and Kennedy rapid transit lines mentioned earlier. In arriving at these decisions, the computer analized such factors as the operating performance of the rolling stock to be used, the curvature of track, grades, distance between stations and similar factors. The engineering department has also simulated by means of the computer the operation of an interlocking plant controlling a complicated intersection of a number of routes.

"Another use of computers which would be of great value to our industry also is exemplified in the new system being built by the San Francisco Bay Area Rapid Transit District," Gaul said.

The San Francisco system will be more of a suburban commuter operation rather than an inner-city operation. A suburban operation of this type cannot use a flat fare system such as would be used on an inner-city system. Therefore, its fare structure must be related to the distance travelled. To monitor a fare structure of this type without a large amount of manpower such as used on commuter railroads, automatic fare collection equipment is being manufactured and installed by IBM.

A simplified description of this system would indicate that the passengers purchase magnetically-coded tickets which permit them to ride from their point of origin to their destination. Under such automatic fare collection, the rider inserts the magnetically-coded ticket in a turnstile when he enters his station of origin and then inserts the ticket again in a turnstile at the station of exit. The

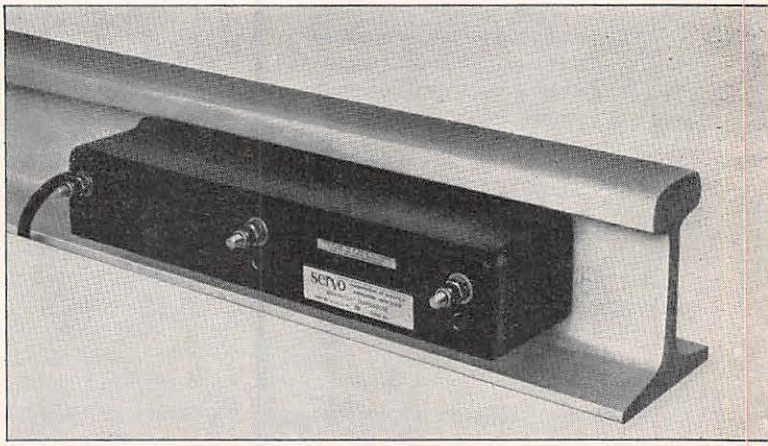
(Please turn to page 35)

"According to the extensive calculations of our C&S department, Servo's new magnetic transducers oughtta be installed right about here."

ANY railroad man, from our lonely friend of 100 years ago to his modern counterpart of today, could be expected to ask the question: "But what will Servo's transducers do once they've been installed?" And that brings us right to the point.

SERVOPOLE® and SERVOTRIP® rail-mounted transducers are variable reluctance magnetic sensing units capable of detecting wheel presence on railroad rolling stock. Passage of a wheel over the transducer generates sufficient power to energize a relay directly, without signal amplification. Actual contact with the wheel flange is not required. These new transducers have been designed to serve as basic building blocks for a wide variety of railroad control systems. Typical applications include: speed selective grade crossing controls; transducer track circuits; grade crossing restart control; track shunting; classification yard carstop retarder control; car and train arrival annunciators; car and axle counting; train length measurement; speed and acceleration measurements. In each of these and many other applications, the basic signal to the control system is simply and reliably derived from the magnetic transducer, which operates completely independent of track ballast conditions.

Would you like to know more about these versatile units, including technical description, specifications and application notes? Just ask for Tech Data Publication 2016.



SERVOPOLE® Rail-Mounted Magnetic Sensing Transducer is a dual-segment unit for use where directional information is required. Another model, SERVOTRIP®, is a single-segment transducer for applications where direction sensing is not required. The transducers have no moving parts—all internal components are encapsulated and mounted in a rugged fiberglass-reinforced housing. A complete selection of associated control units is also available from Servo, including: timers, directional sensors and analyzers, speed selectors, relays, etc.

SERVO SYSTEM SERVICE—Servo Corporation of America backs up its railroad products with dependable support and assistance—site survey, application engineering, detailed proposal, installation checkout, plus field service and personnel training.

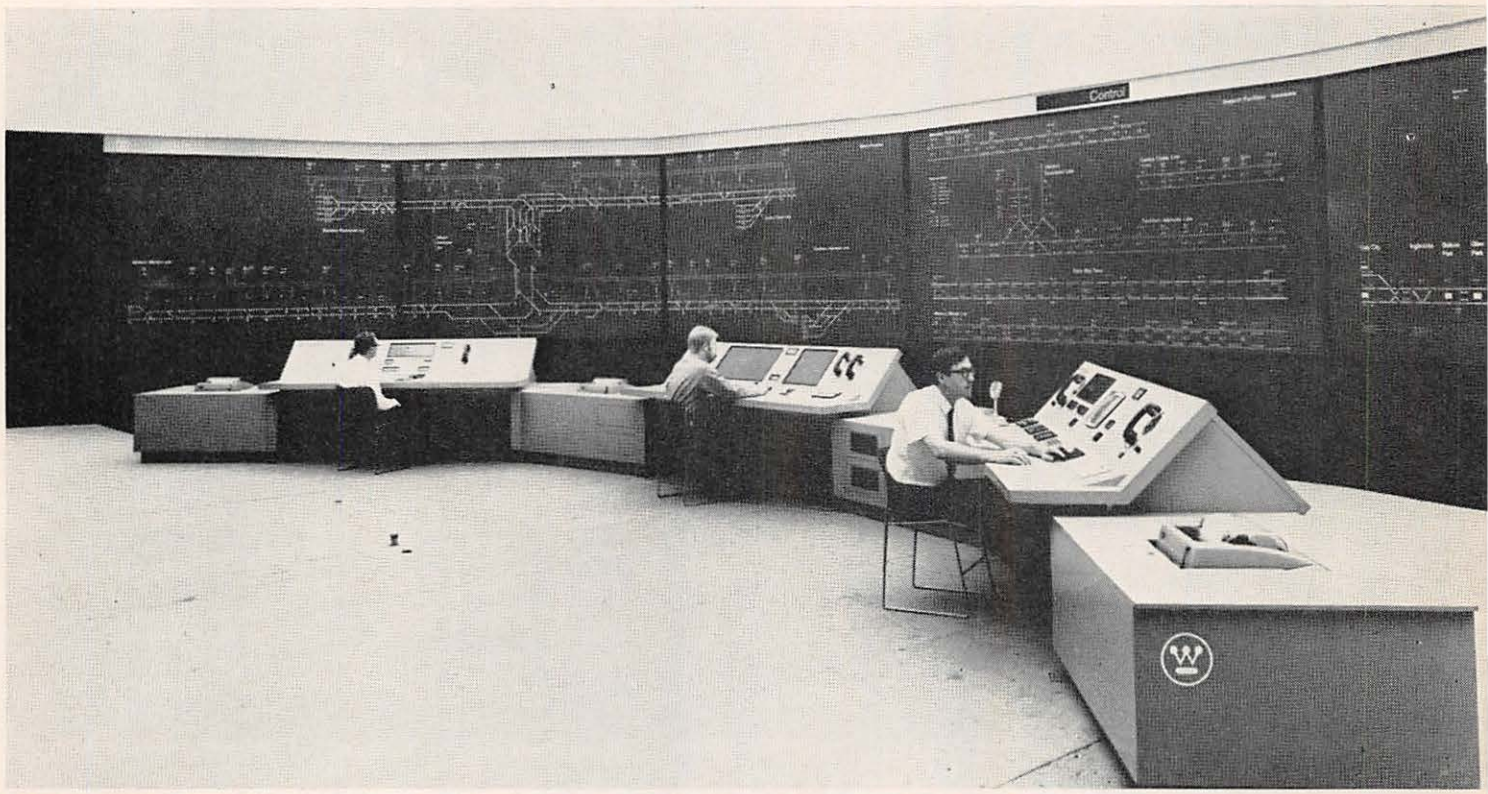
servo corporation of america

servo

railroad products
111 new south road
hicksville, n.y. 11802
516-938-9700

MEMBER RPI RAILWAY PROGRESS INSTITUTE

Circle 11 on reader service card



BART CONTROL CENTER has consoles and displays for electrification (left), support units and train control (right).

BART controls "dry run" tested

The world's first completely automated rail transit system made a "dry run" on March 3 on a track-model panel at control headquarters in Oakland, Calif.

A ribbon of red lights unrolled to simulate a 20-mile "trip" from BART's Southern Alameda yard near Union City to Oakland's MacArthur station in five minutes. Actual running time will be 27 minutes when the 75-mile aerial, underwater and underground system becomes fully operational in 1972.

The lights traced the phantom trip as Westinghouse Electric Corp. unveiled its automatic train control and communications system designed for Bay Area Rapid Transit trains. The control center features three consoles monitoring 8-ft-tall display boards stretching 88 ft. across a room one floor below BART's Lake Merritt station entrance in Oakland.

"The central control room is the system nerve center which will automatically supervise and dispatch BART trains keyed to passenger demands, safely and with minimum delay," said J. William Brownson, Westinghouse manager of train control.

"In an adjoining room are the computers, essential brains of this coordinated transportation system. They must make judgments regarding peak hour train performance every half second, too swiftly for human response."

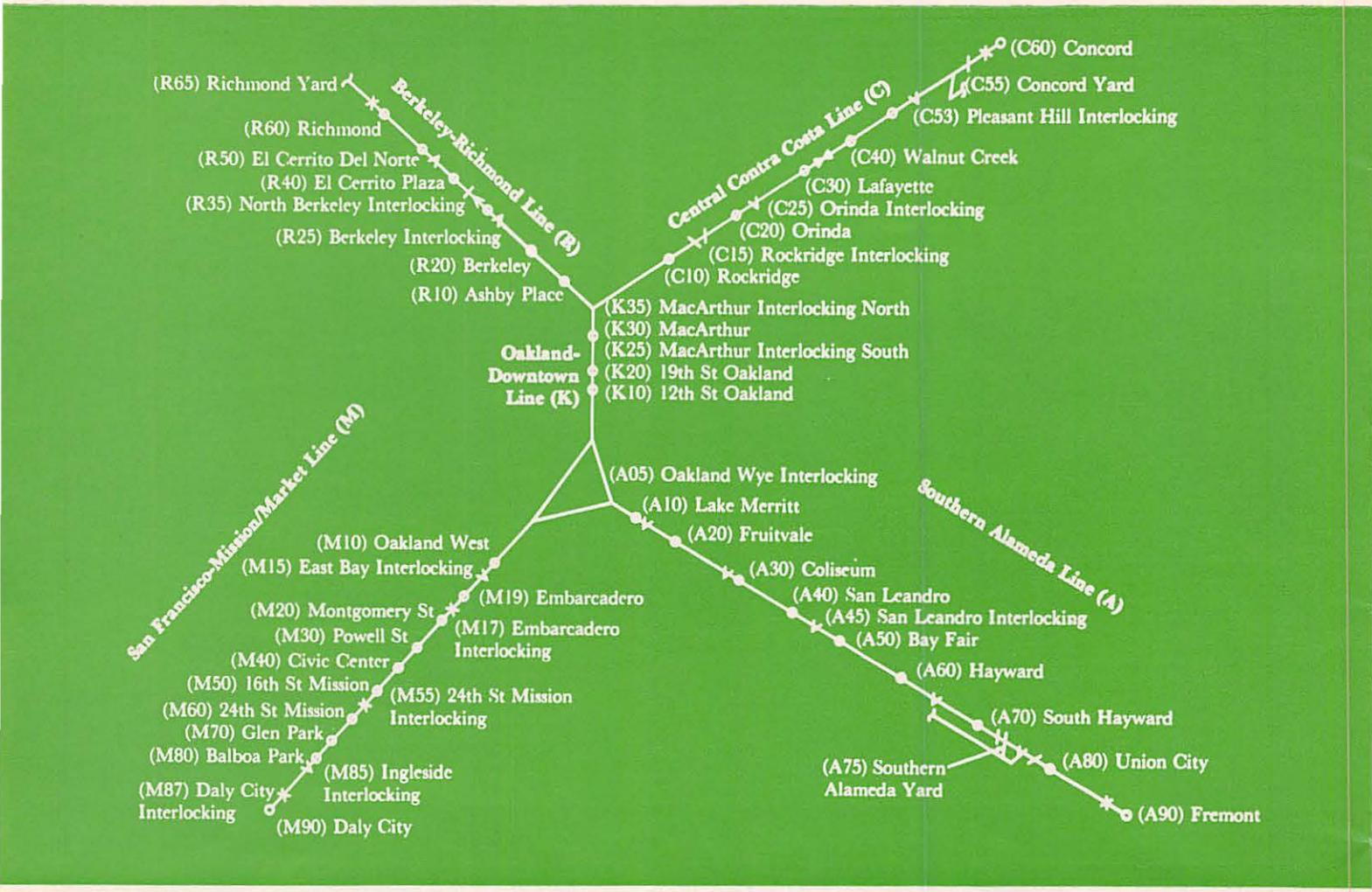
Eighty-mile-an-hour top speeds will be attained by trains operating 90 seconds apart during some periods.

Every conceivable incident that could be foreseen on such a sophisticated urban transit system was cranked into the computers for analysis and paper solution during the programming which began in 1967, Brownson pointed out.

The Westinghouse contract for automatic train control and communications equipment provides for programming to continue one year after the initial system is operational. This will enable BART officials to plot future strategies to meet traffic situations which will become obvious only after the system starts up, Brownson explained. These studies will utilize a backup computer,

MANAGEMENT INFORMATION

Computers are in place, programs are being tested, and shortly test cars will again be running over a section of the completed BART system to provide realtime testing of "trains" under completely automatic control. Plans call for the automatic train control and computer systems to be ready for the first prototype cars that will arrive in August.



CONTROL LOCATIONS shown by letter and two digits are where train routing or sequence changes can be made.

standing by to meet any emergency and also for attendant training when trains start running.

The console operator can light up on the board any one of the five BART lines, serving San Francisco and three counties on Oakland side of San Francisco Bay, or any combination of them. White lights along a track section will indicate all systems are clear and the track unoccupied; red lights will indicate the track is occupied.

As part of the communications facility, the console operator can communicate directly by radio telephone with attendants aboard individual trains. He can also make live voice announcements at all passenger stations.

The central control facility is linked to control rooms at each of BART's 34 stations, which in turn will be responsible for train safety, switching and station stop duration.

A middle console and accompanying display board controls the system support facilities, such as the ventilation fans, fire alarms, sump pumps and emergency telephones.

The third console and board permits instant control of the system's electrification facilities, such as the third rail power supply.

In the event of any power interruption to the train control system, there are racks of storage batteries in a lower level room standing by to supply electric power instantly.

The first segment of the system—a 23-mile stretch from Hayward to downtown Oakland—will be in operation in 1971; the entire system is scheduled to be in operation in 1972.

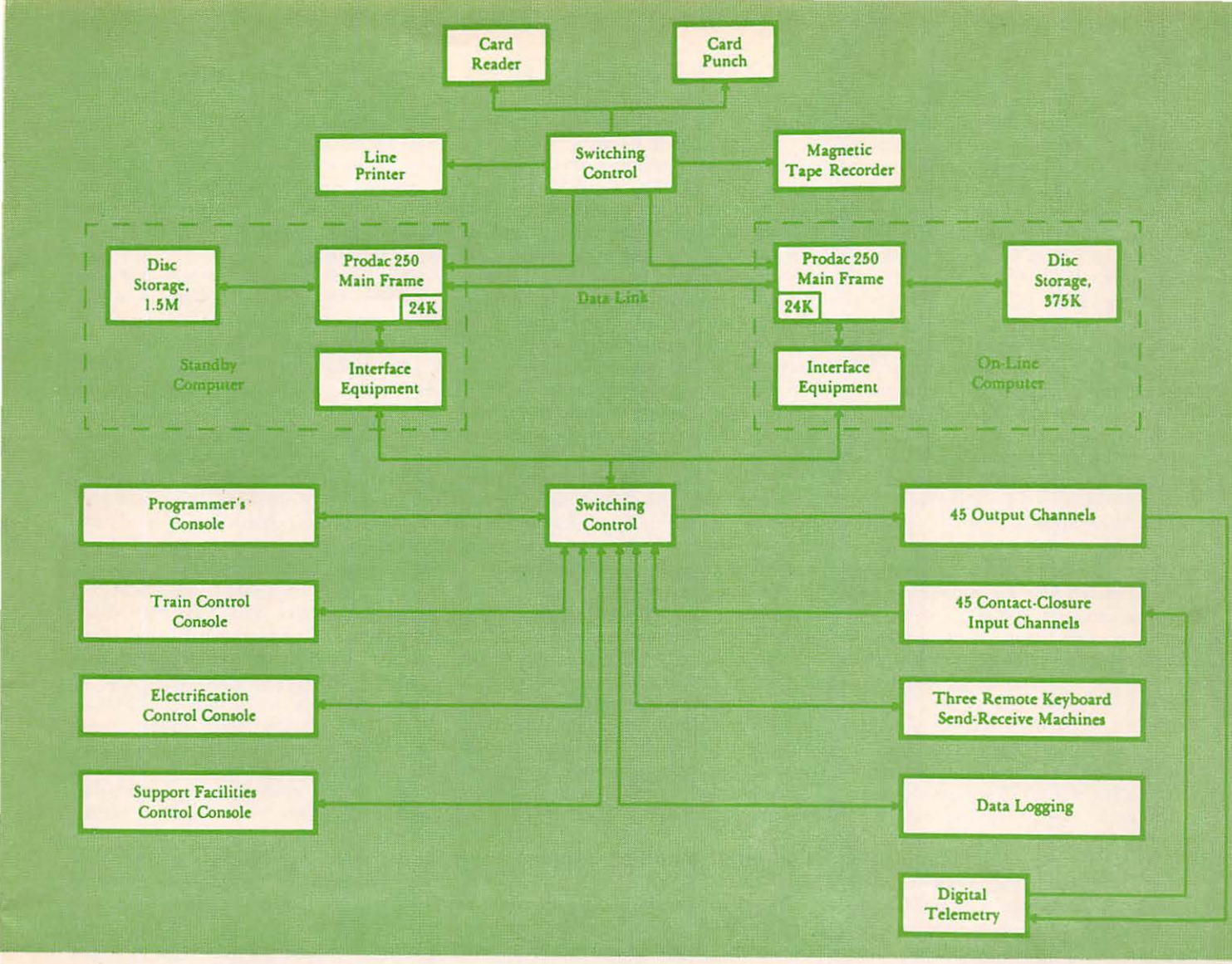
BART will have as many as 105 trains in operation during peak hours, running on headways as close as 90 seconds through the Oakland "Y" area (MacArthur to 12th Street). The 72-passenger cars assembled in trains up to 10 cars long will be operated at speeds approaching 80 mph, with absolute passenger safety. Average speed, including 20-second station stops, will be 50 mph.

The computer-supervised transit control system will make the many BART trains operate as a coordinated system. It will operate the vehicles and supervise train scheduling and routing while automatically preventing collisions.

The BART control system will keep the trains on schedule to the degree possible. As unavoidable delays occur, however, it will continually adjust the schedule of each train to maintain a spacing that minimizes passenger waiting time at the various stations.

The system includes a central control complex, located adjacent to the BART administration building near downtown Oakland, local control units at the 34 stations and at the train yards, car-mounted control packages, and the communications equipment required to link the system together.

The local control units are used for control of all functions of the transit system relating to safety, such as protective train spacing, overspeed prevention, and the locking of switches to prevent misrouting. The central computer control is used for coordinating functions such as system optimization. The safety functions of the local system cannot be overridden by the central



BART CENTRAL CONTROL equipment is linked through two process control computers.

```
TRAIN 105 DEPARTED FROM A40 AT 130223
     TRAIN NOW RUNNING AT P.L. 1
     TRAIN PREDICTED TO ARRIVE AT A30 AT 130403
     TRAIN WILL HAVE A RANDOM DELAY OF   10 SECONDS
     TRAIN BEHIND SCHEDULE BY 152 SECONDS
     DISTRIBUTE HEADWAYS OF TRAINS AHEAD OF THIS TRAIN
     AT CP   4 OFFSET TRAIN 104 BY    90 SECS
     OFFSET THEOR. SCH. OF TRAIN 104 IMMEDIATELY BY   101 SECS
      A LINE, REVERSE DIRECTION, TRAIN SERIAL NUMBER 104
        -104   124500    124544   124604    124754   124754
      124838   124858    125048   125048    125132   125157
      125347   125347    125431   125451    125641   125711
      125755   125755    125945   130005    130155   130155
      130239  -130349   -130513  -130513

TRAIN 306 ARRIVED AT M55 AT 130231
TRAIN 306 DEPARTED FROM M55 AT 130231
     TRAIN CONTINUES RUNNING AT P.L. 2
     TRAIN PREDICTED TO ARRIVE AT M50 AT 130315
     TRAIN BEHIND SCHEDULE BY  -0 SECONDS
     CONTINUE WITH EXISTING SCHEDULE

TRAIN 305 ARRIVED AT M20 AT 130233
     NEW MINIMUM DWELL    14 SECS
     DWELL AT THIS STATION WILL BE   20 SECS
```

SIMULATION PRINTOUT shows train operation and strategies applied.

computer, but some nonsafety functions also performed by the local system, such as station dwell time, normally will be overridden by the central computer in the process of optimizing system service.

The train control and communications system is being provided under a $26 million prime contract by the Westinghouse Electric Corp. Under a separate subcontract from the BART car builder, Rohr Corp., Westinghouse is providing all elements for movement and electrification of the system's 250 initial cars, including propulsion and propulsion control equipment, brakes, trucks complete with wheels and axles, air suspension, air conditioning, and auxiliary power.

The concept of automated train control developed by BART engineers combines for the first time all the functions required to operate trains without human intervention: regulation of individual train movement from starting to stopping; determination of the routes the trains will take; and control of scheduling to keep trains spaced for

optimum station service.

Train acceleration and braking is smooth, safe, and fully automatic. The trains stop precisely at the platforms and open and close their doors, without human assistance. A train attendant will be on board, however, and will be able to press a button to bring the train to a stop or operate it in an emergency.

Between stations, trains are under the direct control of a new system of train protection designed by Westinghouse based on modern information theory and solid-state components. When this concept demonstrated its feasibility in early 1967, it became the basis for the Westinghouse low bid because it substantially reduced the cost of installation and equipment.

The Westinghouse system relies on dependable track circuits to detect whether a given block is occupied and, based on this knowledge, to lock switches and to deliver speed commands to the trains. Each track circuit constitutes a block. Speed signals come from a wayside transmitter at the end of each track circuit, coupled to the track by an electrical inductive loop. The signals are in the form of a digital code created by frequency-shift keying of audio frequency signals.

On each train, receiving equipment decodes the signals and converts them into control commands for equipment on each of the cars. As a train approaches a station platform, a signal from a special control system is superimposed on the block signal and brings the train to a stop within 5 ft. of target. An encapsulated flat cable, with two conductors crossed over each other every foot, is laid along the rails at each station. An antenna on the train senses this crossover and produces a distance measurement independent of wheel rotation. A stored program computes the distance to go and controls braking to a smooth, precise stop. The train doors then open automatically for a period determined by the central control—normally for 20 seconds, unless scheduling adjustments are being made.

A high-speed digital telemetry system provides communications between the central control complex and 45 local terminals which monitor the field devices. The telemetry equipment operates at 1200 bits per second, allowing the computer to scan each of the 8,000 telemetry points on the system at least once every half second.

Located on two underground levels adjacent to the Lake Merritt Station near downtown Oakland is BART's central control complex. It is actually an underground extension of the BART administration building, also being built at the Lake Merritt site.

The central control complex consists of two Westinghouse Prodac 250 computers and associated peripheral and support equipment. One of the computers, the on-line unit, supervises scheduling and monitors the operation of the network. The second computer, the standby unit, provides complete backup for the on-line unit as well as simulation of the system for off-line experimentation and for operator training.

Guided by the operating schedules, the computer checks for correct train makeup, determines departure times from yards and stations, and sees that the trains are properly routed. It requests train speed adjustments and makes other corrections to ensure a high standard of service throughout the system. Some of these corrective strategies are: distribute the intervals between trains, adjust station dwell time, control the sequence of trains, and revise train dispatch schedule.

The computer keeps track of train speeds and schedules and displays these on request. For maintenance purposes, it keeps records of accumulated car miles and operating hours by coupling train identification numbers with automatic car identification data from cars departing the yards. The computer can also analyze system power consumption based on data brought in from remote sensors.

Computer monitors support units

In addition, the computer monitors the operation of equipment such as fans, vents, circuit breakers, and pumps. In case a unit malfunctions, the computer alarms the operator and logs both the nature of the malfunction and the operator's response to the alarm.

Another important job of the computer is to operate the three central display boards that show system status. These display boards consist of six 12-ft sections and one 16-ft section. Each are 8 ft high and only 5½" deep. Basic structure is aluminum with a special Data-Film and glass panel face. Any of four colors can be shown for tracks and legends. Letters are ¾" with tracks ⅜" wide. All wiring of the panels is brought to 50-pin connectors for ease of installation. Each panel has a fused ground probe for checking any of the 35,000 lamps quickly. Replacement of lamps is all the maintenance that is required and that is handled from the rear of the panel. These display panels were manufactured by TEC, Inc., formerly Transistor Electronics Corp.

One display board shows train operation. It is for a train control console. The board is normally not illuminated; however, the console operator (equivalent to a train dispatcher) can display any one or combination of the five lines (Southern Alameda, Downtown Oakland, San Francisco, Concord, Richmond) or any specific interlocking or combination of interlocking zones. A specific location will also light up when an alarm condition comes in from the field from that zone. A white illuminated track section indicates nonoccupancy, while red indicates occupancy.

The train control console operator can also talk to the individual trains via radio, and he can make announcements at passenger stations.

A second console is used to control system support facilities, which are located mostly underground and include such things as ventilation dampers, fans, and water pumps. The display board behind this console shows the operational status of these facilities, and also displays alarm conditions like station trouble, fire, or communications failure. In addition, this board shows the occupancy of each 1,000-ft section of the tube under the San Francisco Bay. Emergency telephones located frequently through the underground sections, in station agents booths, and at yards terminate at this second console.

A third console and display board serve the system's electrification facilities. They correspond to the conventional power-controller or power-dispatcher position in an electric utility or electric railroad facility. Among the major items they monitor and display are the status of the high-voltage and low-voltage circuit breakers and the power contact rails.

Programs are entered into the computer through a widely known computer language, FORTRAN IV, making it relatively easy for BART programmers to communicate with it. Based on their importance, program routines are assigned one of three class levels. The Executive level is devoted to the most critical programs required both by the computer and the BART system; these programs normally remain fixed and may only be altered by an authorized person. The Resident Foreground level is devoted to high-priority programs which will usually require periodic change, but which are frequently used in the control process. The Background level is devoted to the storage of data and to low-priority programs which have only periodic use.

Each of the Prodac 250 computers has a high-speed core memory capacity of 24,000 words in its main frame. About 25% of this high-speed memory is devoted to programs of the first two class levels, with the remainder kept available for the processing and temporary storage of the data and other program routines. The computer assigned to on-line operation has a disc for bulk storage with an additional 375,000-word capacity. Because some additional off-line work, such as train-

control simulation, is done solely by the standby computer, it has a much larger, 1,500,000-word bulk storage disc capacity.

Probably the most important and valuable function of the BART central computer control is its unique ability to supervise operation of the network to see that daily train schedules that minimize operating costs are maintained as closely as possible, while at the same time meeting service standards.

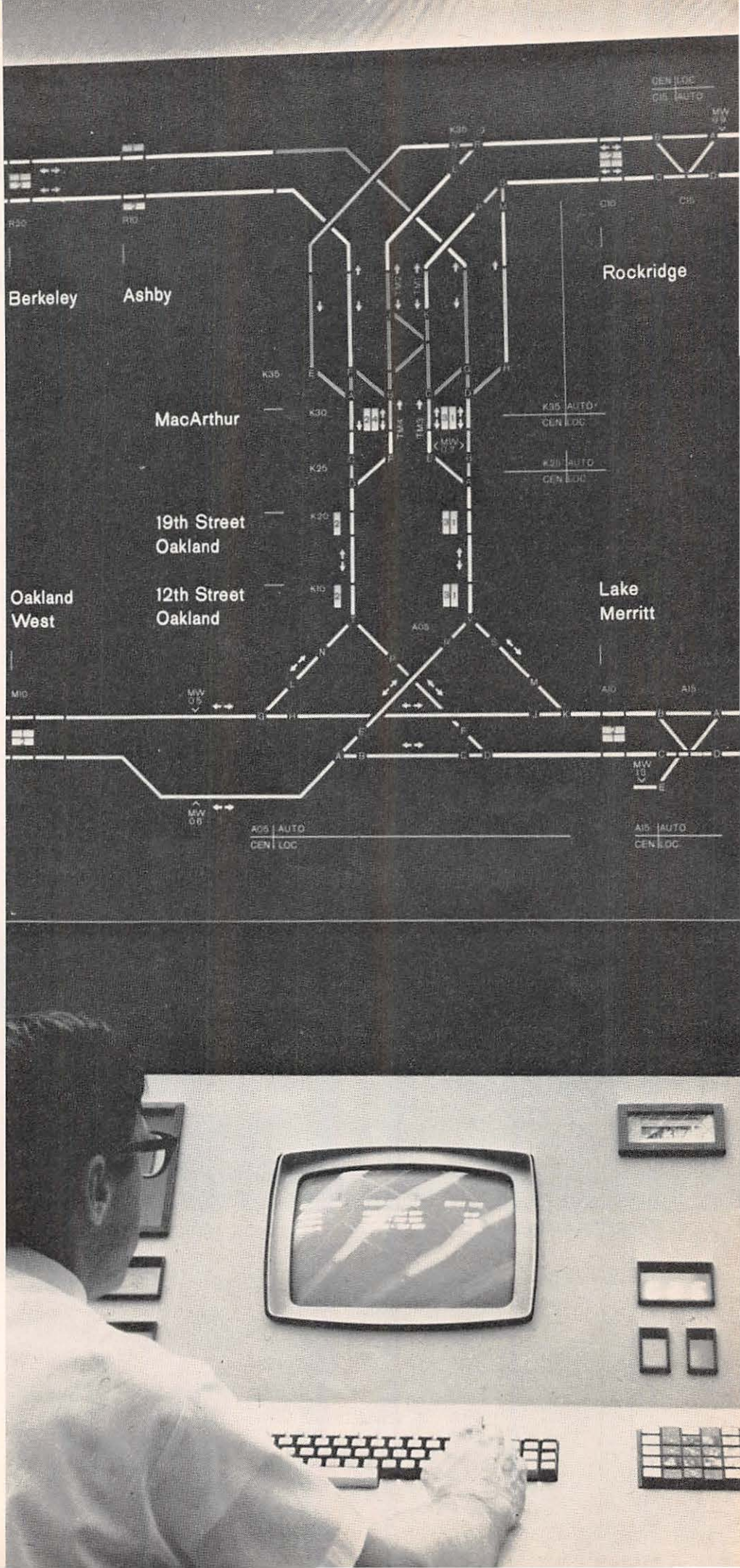
A control strategy that could perform these optimizing functions was developed and tested using a rapid transit simulation program and a large digital computer.

The program describes the real-life system. It includes a model, which is essentially a tabular representation of the BART system corresponding to the discrete locations where information for control is obtained and where control adjustments can be made.

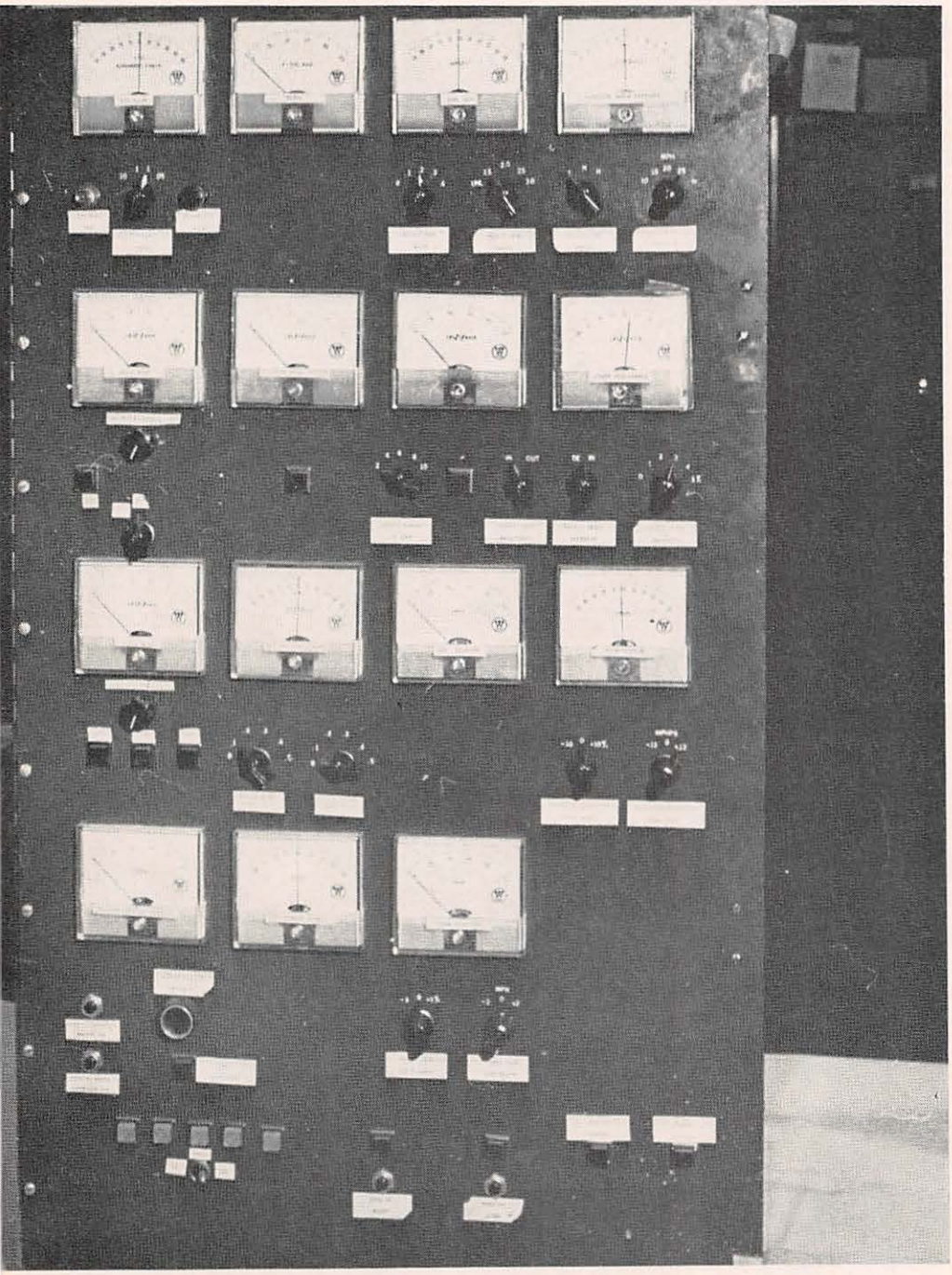
The simulation program proved invaluable in analyzing the BART system and in formulating and testing the control strategy logic. Even for simple control adjustments like changes in permitted maximum speed or station dwell time, pitfalls were encountered that otherwise wouldn't have shown up until much later when changes would have been difficult or impossible. Now kept in the backup computer in the central control complex, the simulation program will continue to serve BART each time it wants to test out any proposed change in system operation, especially as passenger load demands change in future years.

The system control strategy developed for BART starts by establishing, at the beginning of each day, a theoretical schedule of arrival and departure times from 53 critical locations —34 stations plus 19 other locations at which a routing change or train sequence change may be made. A schedule is established at these locations for each of the 105 trains which may be operating on the network. Each train identifies itself as it arrives at a critical point and its actual arrival time is compared to the theoretical arrival time by the central computer.

The control strategy logic, then, has the task of determining which corrective action will result in the least favorable consequences. These are defined to mean that a uniform gap (time between departure of one train and arrival of the next at a station) is more important than the theoretical schedule arrival and departure times. This means possibly slowing trains ahead of a delayed train to make the gaps more uniform. To bring the system back to theoretical schedule, all trains are dispatched from the turnback at the theoretical schedule dispatch time.



Automatic train stopping has been



CONTROL PANEL provides for monitor-set of various system parameters.

By G. M. Thorne-Booth
Manager, Communications & Control

R. P. S. Kalra
Communications & Control
Westinghouse Electric Corp.

Precision stopping equipment has become a requirement for most modern rapid transit systems. This is so because of two reasons. First, modern systems require air conditioned platforms for passenger comfort requiring stops with very tight tolerances which will permit the vehicle doors to line up with the platform doors (fitted to reduce air flow). Secondly, if the stopping position of the train can be specified accurately, the passengers can position themselves along the platform before the train arrives, thus avoiding confusion and reducing dwell times at stations to a minimum.

In order to satisfy these requirements a precision stopping system must be able to stop a train within a few inches of the stopping point when it approaches the stop under varying initial conditions of velocity and acceleration. The stop must be accomplished in the presence of normal instrument errors and varying amounts of wheel wear. This calls for a closed loop feedback control system for precision stop. Further, the vehicle should be stopped in minimum time consistent with passenger comfort.

Westinghouse precise stop equipment is so designed as to accomplish precise stop of a vehicle to a standard deviation of 6 inches. The system utilizes signals, obtained from transposed cable laid along the track and a hand-wired computer on the train, to determine the control signals to the propulsion circuit. The result is a smooth, comfortable stopping profile of minimum time and maximum accuracy, which is maintained regardless of train length, reasonable instrumentation errors, or operating condition. Complete automation provides reliable operation with a high degree of flexibility.

A precise stop is initiated by a vehicle passing over an encapsulated transmission cable 2.5 inches wide which is fitted longitudinally along the track. An antenna system coupled to the transposed cable provides a count for train location determination and a speed measurement which is independent of wheel rotation. The count which the

developed for rapid transit

antenna receives, by observing the crossover in the cable is fed to a digital computer which then computes a signal for the speed regulation system.

Figure 3 shows the velocity time profile for a vehicle with precise stop equipment and without it. In order to insure passenger comfort when beginning and completing a stop, the precise stop at constant deceleration is changed to a precise stop at constant jerk of 1.5 mph/sec. These values may change depending on the passenger comfort index desired.

The acceleration time stopping profile is shown in Figure 4. It also shows the initial conditions and the function of the "flare-out" system.

For a station run through, the precise stop transmitter feeding the transposed cable is switched off and the train will continue through the station under track signalling control. Flexibility in the stopping position is obtained by changing the number of crossovers of the transposed cable to the stopping point. This also can be done by switching the vehicle counter.

Figure 5 shows the control system used for precise stops. Essentially there are two control loops, the velocity loop and the acceleration loop. Under normal operation when the vehicle is runing under track signalling control the velocity loop is used. The acceleration loop control is used only when the train performs a precise stop.

When acceleration loop control is used the acceleration reference is determined by a hard wired computation unit which calculates $V^2/2d$ where V is the velocity of the vehicle and d the distance to go to the stopping point. The distance to go to the stopping point is determined by counting the number of crossovers of the transposed cable, the desired count having been predetermined. The acceleration reference is next compared with the actual deceleration, provided by the accelerometer, to produce an acceleration error which is the p-signal.

A few feet prior to the actual stopping point the flare out system comes into operation. The flare out system changes the stopping profile from constant acceleration to constant jerk. This is done by changing the calculation for acceleration reference to $2V^2/3d$ and increasing the distance to go "d" by 33%. Thus the flare out system allows the train to come to a complete stop with controlled jerk.

MANAGEMENT INFORMATION

Precision stopping of rapid transit trains can be advantageous in not only by being a part of an automatic train operation program, but in being able to have passengers spotted along station platforms at door locations to provide rapid unloading and loading of trains. Automatic stopping of rapid transit vehicles was conducted during 1965 at the BART test track. This article describes a system developed for BART trains. Port Authority Transit Corp. also has the automatic station stopping feature on its trains operating between Philadelphia, Pa., and Lindenwold, New Jersey.

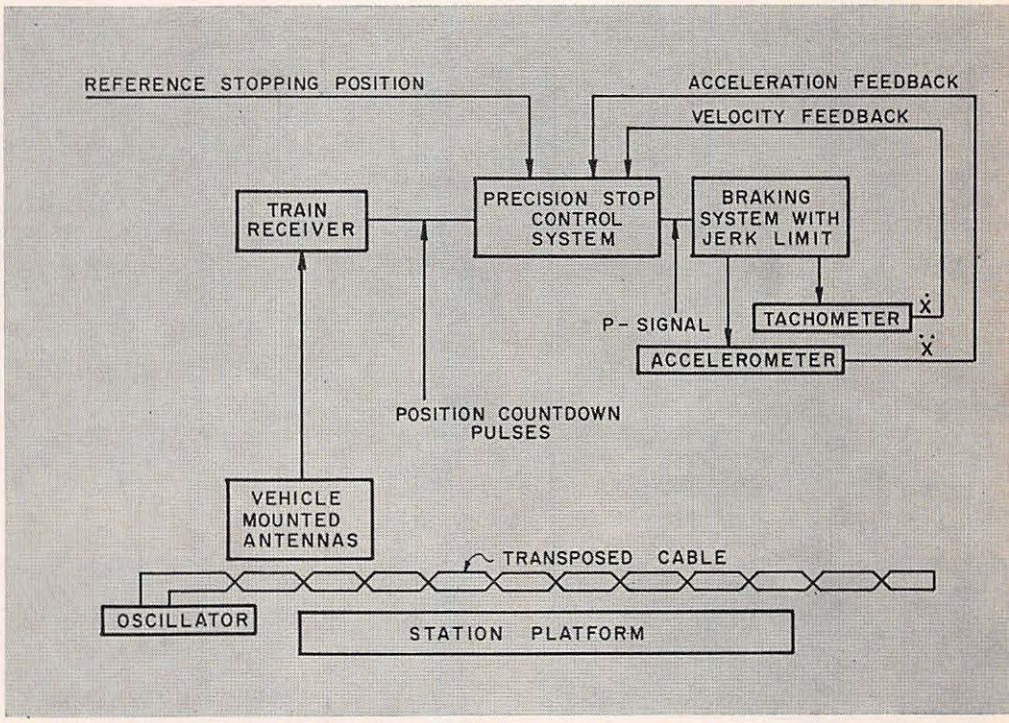


FIGURE 1—Precision stop for horizontal vehicles.

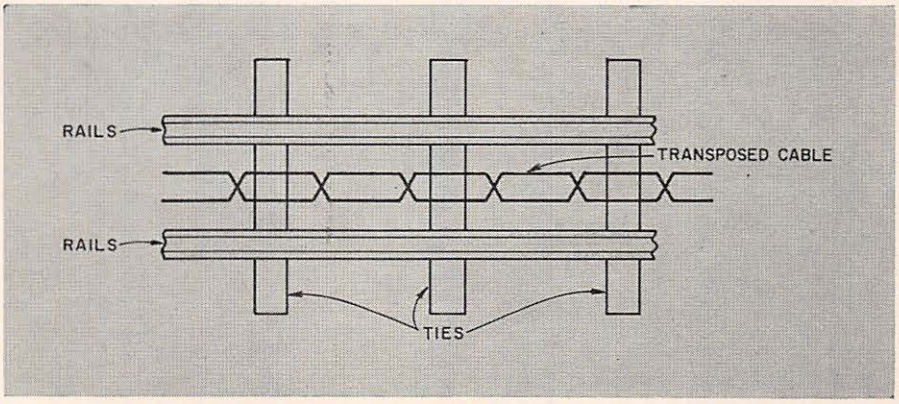


FIGURE 2—Transposed cable for programmed stop.

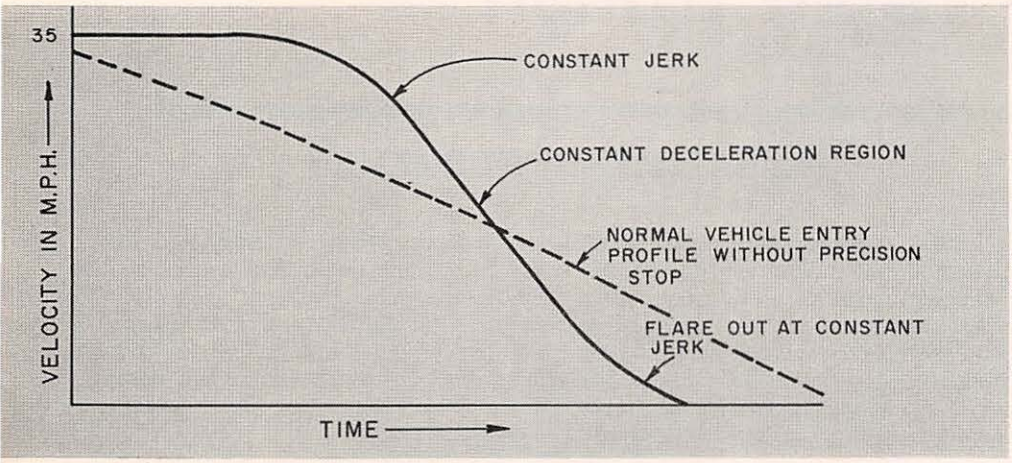


FIGURE 3—Precise stop velocity-time profile.

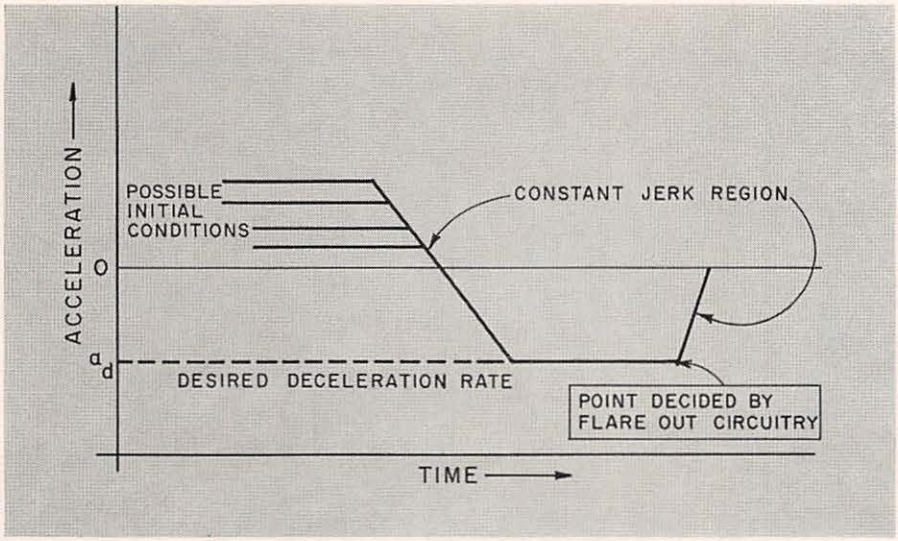


FIGURE 4—Precise stop acceleration-time profile.

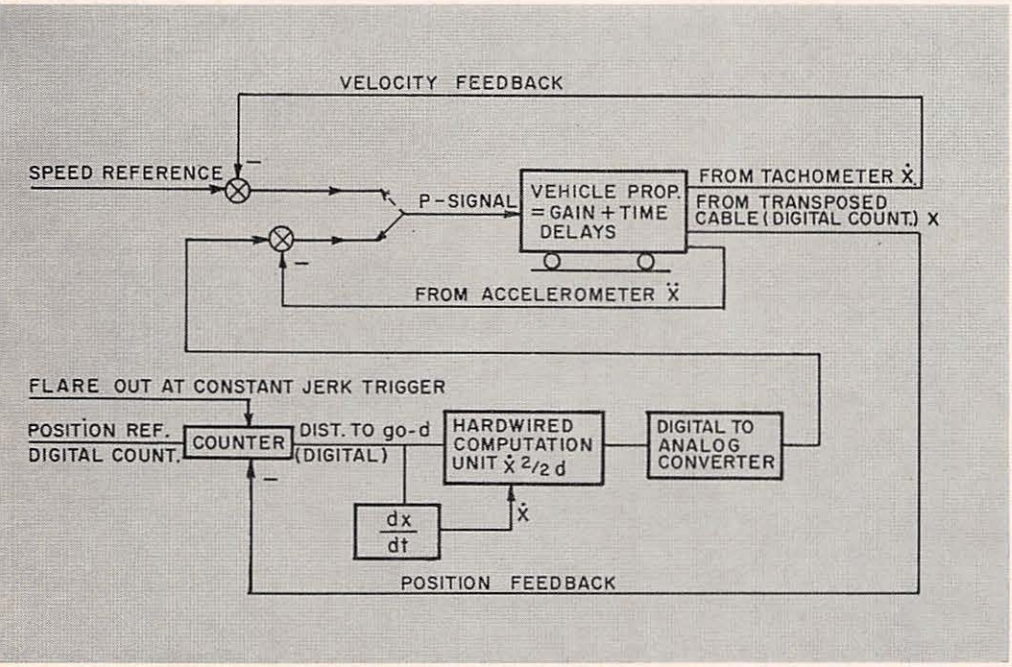


FIGURE 5—Precision station stop control system.

Stability studies of the control system were carried out by simulation of the system on a Burroughs 5500 digital computer using analog Algol. It was found the system could operate without the accelerometer feedback. However, the accelerometer feedback was retained as it helped in stabilizing the system. Higher gains were desirable for accurate stopping in the presence of instrument errors. Therefore the highest gain possible consistent with stability was chosen. It was found that precise stops with standard deviation of 6 inches about the stopping point could be achieved in the presence of ±10% zero errors, ±10% scale errors in the accelerometer and ±5% scale errors in the tachometer.

The sensitivity of the system to tachometer zero errors was also revealed. Consequently the velocity was obtained by differentiating the very accurate determination of position from the transposed cable. This was done digitally. Accordingly, time between two successive crossovers is measured and as the distance between crossovers is known, the velocity can be calculated.

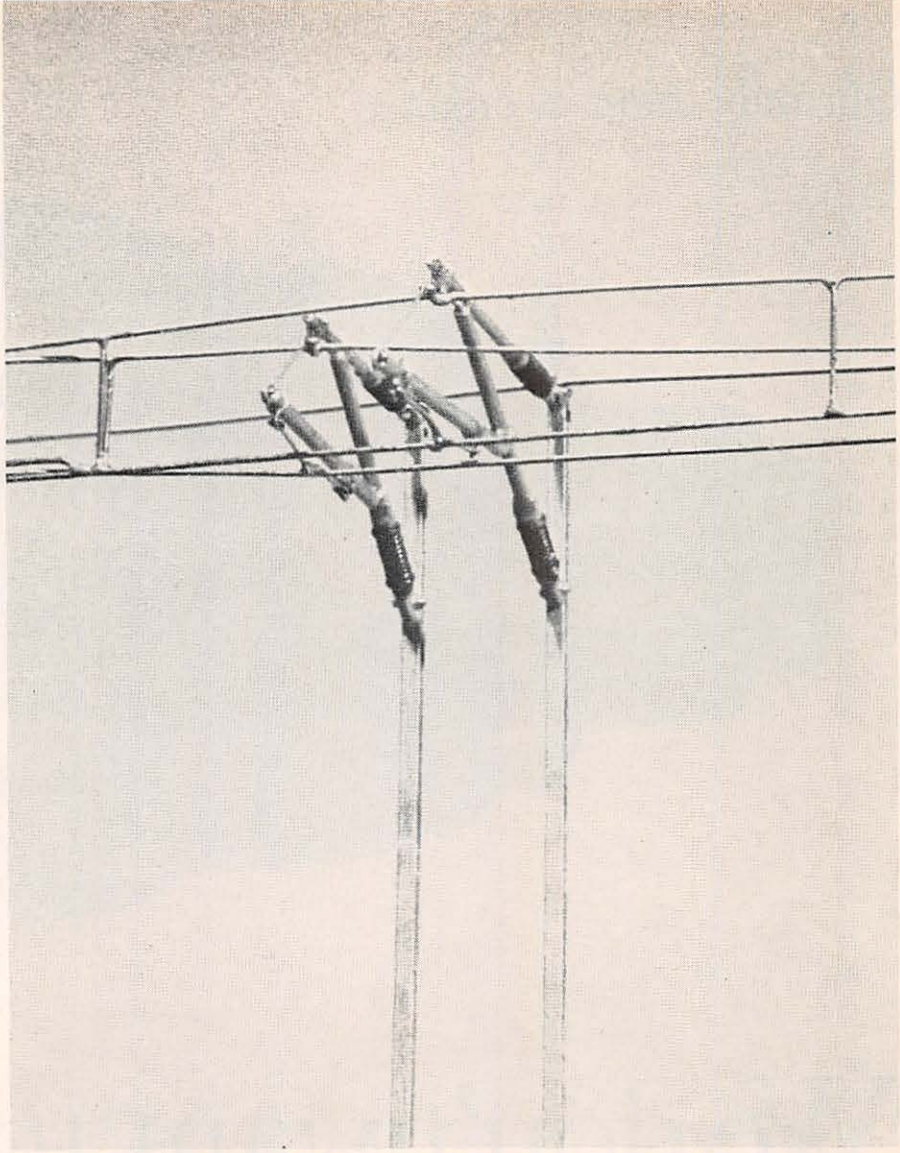
An analog simulator of the vehicle control system for precise stops was next constructed. This was used to check the vehicle stopping profile on board the train. Tests in San Francisco, California and in South Park, Pittsburgh, confirmed the practicability of the system. The first application of this stopping system is on trains of the new automatic transit line of BART in the San Francisco area.

The precise stop equipment does not require an operator to bring the train to an accurate stop and therefore eliminates the human element. This equipment provides reliable operation resulting in greater passenger comfort, less travel time, closer headways and vehicles, improved scheduling, shorter station stops and uniform brake wear. Use of solid state circuitry in plug-in modules allows easy maintenance. The equipment is small in physical size and weight and can be easily accommodated in the attendant's cab.

Precise stop equipment finds wide use in urban transportation, airport systems requiring frequent stops. It is a part of high speed systems in which equipment is needed that will stop the vehicle accurately and keep its deceleration rate close to the limiting adhesion between the rails and wheels. The system also can be easily adapted to yard operations, mining operations and industrial loading and unloading operations.

Electric running has 60 Hz current

S&C circuits have to be isolated from traction current.



ELECTRIFICATION CATENARY handles 50 kv, 60 Hz traction current.

Electrification continues to create interest in the United States, particularly with the technological breakthroughs permitting use of 60 Hz frequency power. At the April 7-8 joint railroad conference in Philadelphia, considerable attention was paid to construction costs for motive power and catenary for distribution of the power to trains. As for the impact on signal and communications facilities, the discussion was mainly confined to present European practices.

As for costs for converting signal and/or communications facilities to operate without intereference from 25 or 50 kv, 60 Hz electrification systems, it was mentioned that such costs are about 5% of the total construction costs for electrification. For the Euston-Manchester electrification system in Great Britain, figures were as high as 19%, but included new signal towers. The costs for isolating signal and/or communications circuits from interference was about 8%.

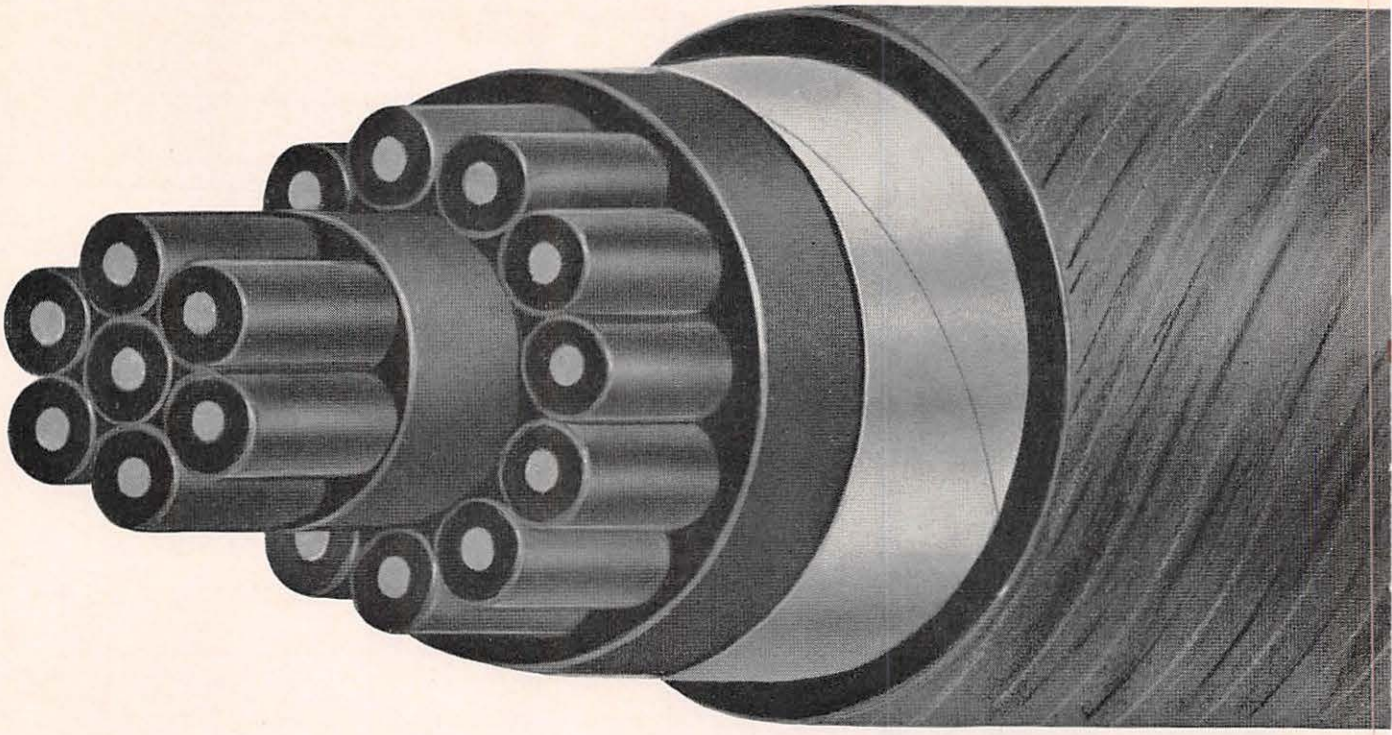
"One of the side effects of AC electrification is the electromagnetic interference to unprotected lineside signaling and telecommunication circuits, particularly open wire lines parallel to the track. Excessive voltages can be generated, and noise can be induced in the speech circuits. These effects can be eliminated by replacing such circuits by a fully screened multi-core cable. The screening normally takes the form of an aluminum layer connected to ground at intervals, and magnetic steel tapes are incorporated in the cable," reported A. D. Suddards, T. H. Rosbotham and T. B. Bamford of British Insulated Callender's Construction Co. Ltd., in a paper presented at this joint American Society of Mechanical Engineers-Institute of Electrical & Electronic Engineers, Inc., conference.

"When there are vulnuerable circuits near the railroad, which cannot be incorporated in a screened cable, a system of booster transformers and return conductors has been used in the United Kingdom. Each catenary has an associated return conductor, supported on the mast at about the same height as the messenger, and insulated for a relatively low voltage (e.g. 3,000 volts). Booster transformers having a 1:1 ratio are installed at intervals of about two miles. The primary winding is connected in series with the catenary, and the secondary winding is connected in series with the return conductor. The return current induced in the return conductor tends to balance the catenary current, and this minimizes the electromagnetic induction. It is still necessary to replace open wire circuits very close to the track by a screened cable of a relatively simple type," BICC engineers reported.

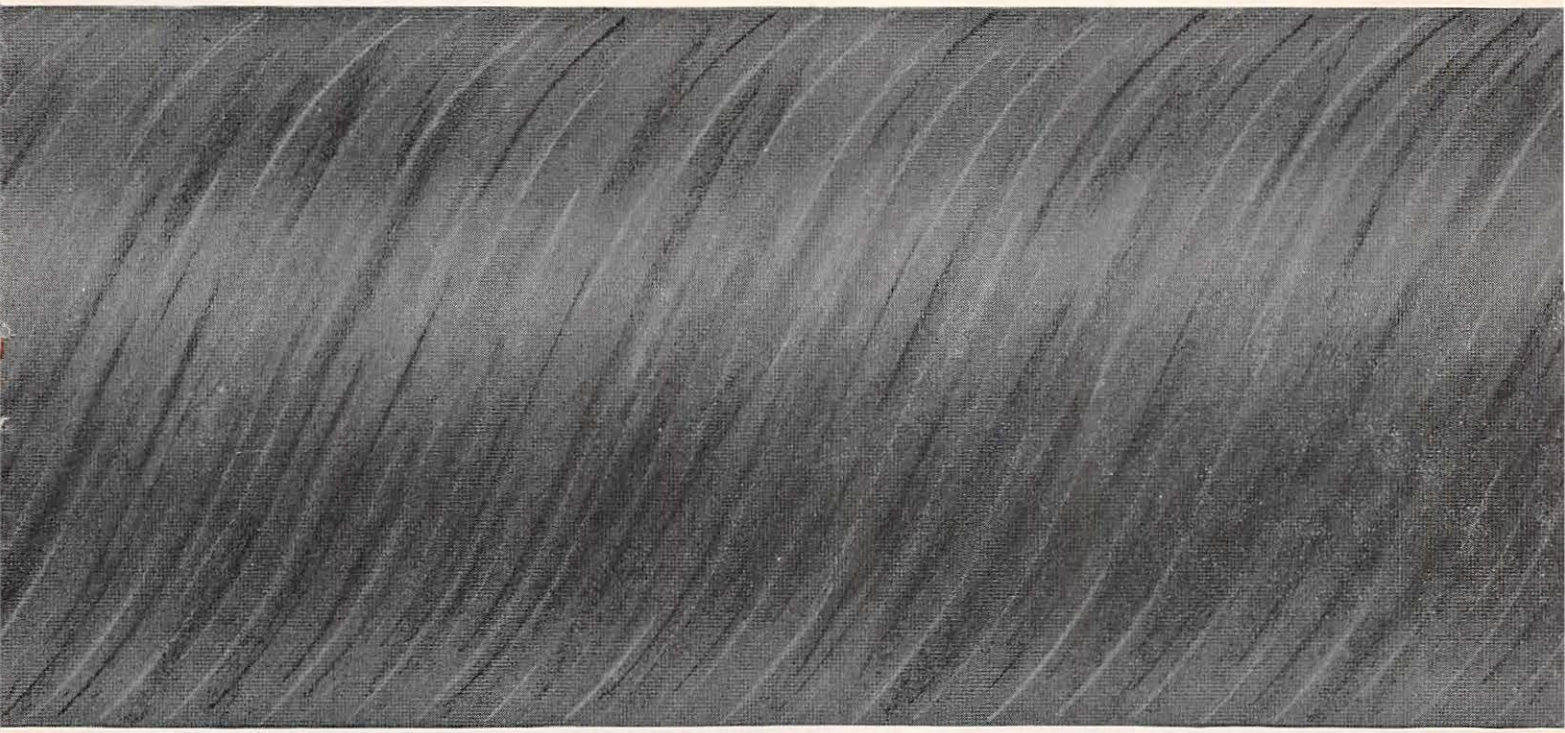
Other British electrification experts reported that experience has shown that in double-track sections where booster transformers with return conductors are provided, the degree of protection to telecommunications cables required to afford adequate immunity to the interference effects of the AC traction current is rather less than was originally allowed. In the situations where no booster transformers exist, or where there are more than two electrified tracks, no relaxation of the original screening arrangements can be contemplated.

All single-rail track circuits on the AC electrified lines were originally limited to 1,500 ft where the traction current was 25 kv and 600 ft in the 6.25 kv area. These lengths were selected in order to insure that the 50 Hz voltage applied across the track circuit relay coils would remain within acceptable limits when the maximum traction return current was flowing in the common rail. Experience has shown that the lengths of single-rail track circuits can be increased to 2,250 ft where 25 kv is in operation and to 900 ft in 6.25 kv territory.

Our only quota is quality.



We don't want to make all the cable, but we are dedicated to making the best.



Our record shows you can depend on it.

The Kerite Company
Principal Offices: New York; Chicago; Seymour, Connecticut
Sales Representation Throughout the United States.
A subsidiary of Harvey Hubbell Incorporated.

MEMBER RPI Kerite

the cable that lasts...and lasts...and lasts...

SP gets data back via TV recordings

What started out as a fast information-retrieval system for the revenue accounting department on Southern Pacific, has become a valuable tool for an operational research program. Called MIST (for Management Information System-Traffic), this research program makes use of information from waybills to prepare a wide variety of periodic reports, some for long-range market research and some for short-range operating decisions such as setting freight rates.

But if the MIST reports are to be useful, the waybill information which they draw upon must be accurate and, for the short-range reports, not more than a week old. "That is why MIST was not practical until we obtained the Videofile system." Bertram T. Nicholls, systems analyst, SP, said.

The Ampex Videofile system was installed to accept and file on video tape the more than 300,000 waybills and related documents presently received at SP each month (it is designed to handle up to 450,000 per month).

Because Southern Pacific keeps waybills and all attendant documents available in various locations for revenue accounting access, this monthly tide of incoming paper had to be collected, sorted, bound and finally made available for retrieval—a process which took about three months before the Videofile system was installed.

With the Videofile system, priority waybills now can be filed and made available for retrieval instantaneously. Even non-priority waybills are entered into the Videofile system within a day or two after they arrive at SP headquarters.

"The first stop for all newly received waybills is computer processing, where their information is tabulated for many purposes. A certain percentage of waybills invariably contain errors; the computer detects these and lists them on printed sheets.

"The errors are corrected manually when the waybills become available in the central file. But before the Videofile system, that was usually a three-month wait.

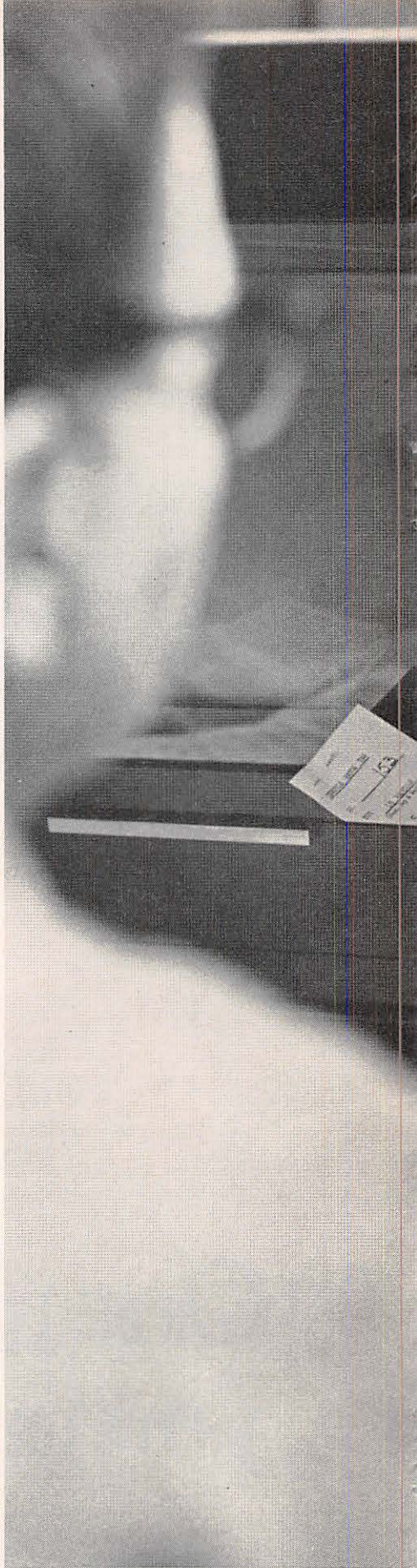
"A program such as MIST requires that the corrections be made quickly so the new information can be re-entered into the computer for corrected tabulations. We couldn't get our hands on the waybills to do that soon enough," said Nicholls.

Newly received waybills now move directly from computer processing to the Videofile system room, where they are entered into the master file as compact recordings on magnetic video tape. (The original waybills are later destroyed.) The new waybills are available for recall as printed copies immediately after being filed on video tape. In cases of extreme priority, waybills can be receivel, computer processed and entered into the Videofile system all on the same day.

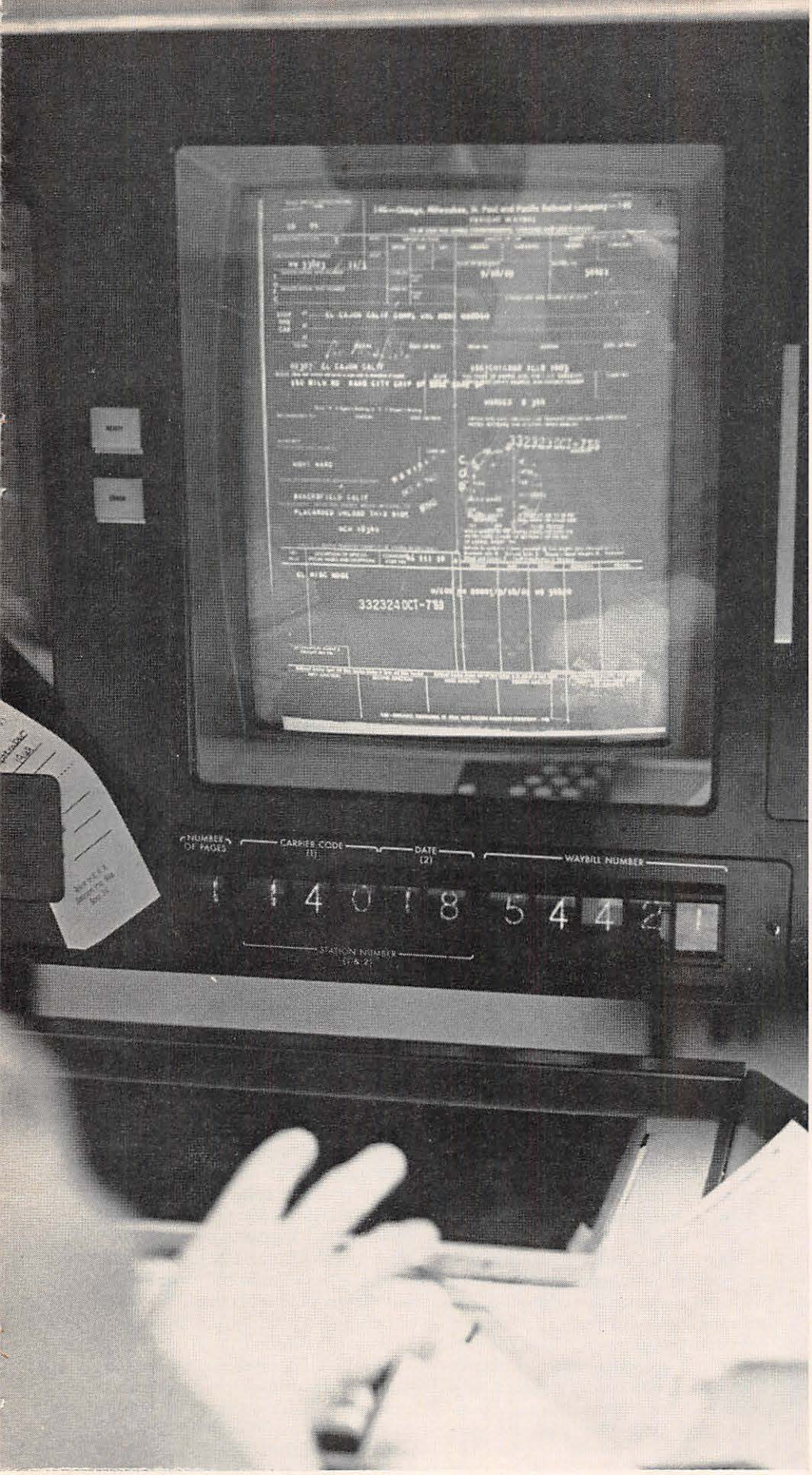
"When the computer identifies a waybill containing errors, it generally produces a punched card with the waybill number and date which can be used soon afterward by a Videofile system operator to retrieve a printed copy of that waybill," Nicholls said.

"The result is that MIST is now a reality. In fact, it is one of the most thorough and accurate management marketing information systems in the railroad industry."

Requests for documents from the Videofile system for MIST studies average 20,000 each month, matching the 20,000 requests per month from the freight revenue department. Handling the total of 40,000 requests per month, the system has continued reliably on



OPERATOR CHECKS TV DISPLAY of way



bill to be entered into Videofile system. Keyboard is for digital addressing.

MANAGEMENT INFORMATION

Fast information retrieval can be a problem, but Southern Pacific finds video tape recording an efficient method to store waybills, yet be able to quickly retrieve the information. An electrostatic printer provides for making hard copies should anyone desire one. Compactness is another asset of the Videofile system—a 2,400-ft reel of 2″ video tape holds 83,000 waybills.

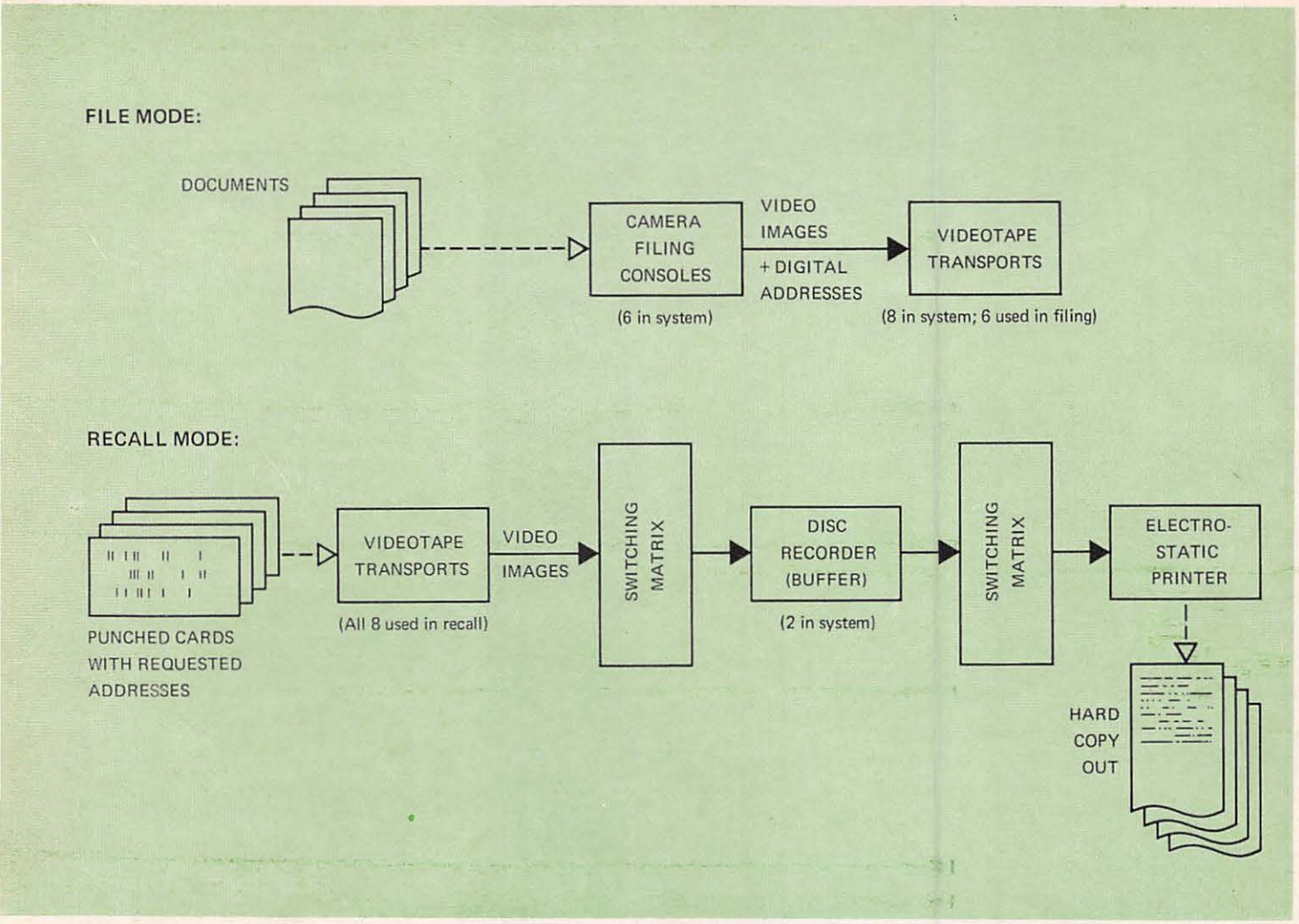
its operating schedule of 24 hours a day, five days a week and on weekends when required.

"The real key is throughput, just as with a large computer system," said Joseph M. Graziani, SP's manager of data processing. "The pertinent question always is: Are we getting the throughput we need and are supposed to be getting? With the Videofile system, we are."

The rate of that needed throughput will increase in the next few years, according to Nicholls. "MIST requests should diminish when a fully computerized system for processing MIST data collection is installed," he said, "but monthly requests for freight revenue purposes should reach about 50,000 by 1974."

The $750,000 Videofile system was placed in operation in July 1968 at which time new waybills were filed on video tape. Already-existent waybills were not converted to video tape. Since waybills are kept for 4 years (ICC rules), in about 2.5 years SP will have all its waybills on the Videofile system. SP installed the system originally for revenue accounting. This would make data contained in incoming waybills available in a few days instead of several weeks. The Videofile system provides faster retrieval and consequently faster settlement where differences are involved.

Broader applications are also being explored by SP management for the Videofile information system. "So far the system has been applied to two activities—freight revenue accounting and MIST," said Herman A. Nelson, vice-president and general auditor. "There are other areas of railroad documentation with comparable needs. Where it is proved practical, we hope to accommodate those needs with the Videofile system."



WAYBILL PICTURE STORED on video film can be retrieved for monitor viewing or copy made for longer usage.

SP VIDEOFILE

Waybill pic on TV film

To file a waybill or other document in the SP Videofile system, an operator seated in front of a filing console places the document face down on a glass plate. Underneath the plate and pointed upward is a high-resolution televison camera which scans the document. To assure that the document is being "televised" properly, its image is shown on a television screen in front of the operator.

The video signals are guided by the system control section of one of eight large tape recording and playback machines (tape transports) and recorded on magnetic video tape. A second set of signals is sent to the tape transport at the same time, but in computer language. These signals (digital address code) are keyed in by the operator while the document is being televised, and are recorded on the tape adjacent to the document recording. The address identifies the document so it can be received quickly.

To retrieve an October waybill, for example, a request card punched with the document's address code is inserted in a card reader in front of the tape transport on which the October reel of video tape is placed. From the card reader's signals, the control system directs the tape transport to search the tape for that document.

Once found, the document recording is played back by the transport into a temporary-store recorder (buffer section). There a metal disc magnetically records the incoming signals, duplicating the document recording. The disc then plays the recording back through a printer to produce a hard copy.

Since the magnetic disc merely duplicates the original document recording that remains on tape in the master file, no entry is ever "out of file" to other requests.

SP uses reels holding up to 2,400 ft of 2"-wide video tape, capable of storing more than 83,000 document recordings. That many paper documents would require eight 4-drawer file cabinets. (Standard 3,600-ft reels store approximately 125,000 recordings). Total storage capacity of the system is limited only by the number of tape reels used. Reels are stored and placed on the tape transports when needed.

On Videofile systems in general, the unique properties of magnetic tape allow documents to be added to existing tape files wherever and whenever desired. They also may be erased, replaced or updated within the file without disturbing adjacent information on the tape. SP's requirements, however, are satisfied by adding corrections to the ends of existing tapes through the simultaneous use of up to six filing consoles.

Southern ups efficiency via EDP

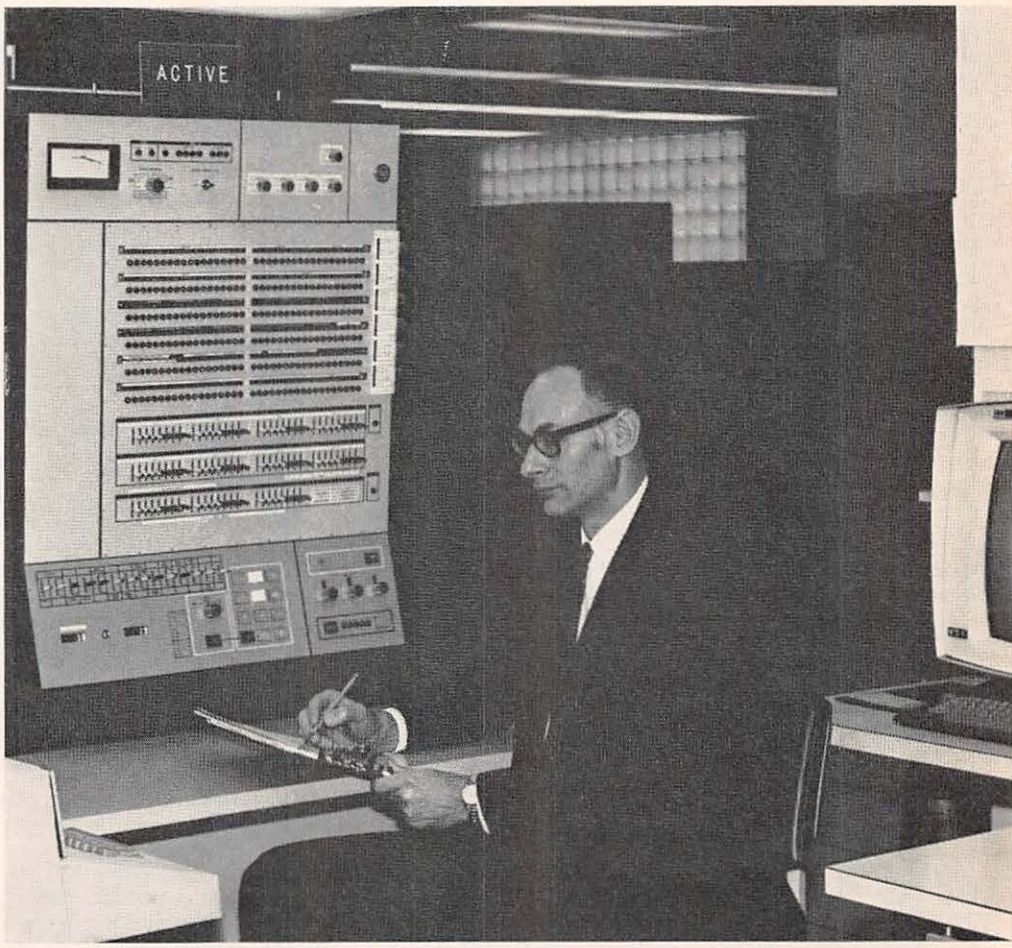
In an interview with Railway Age editor Luther Miller, Southern's vice-president management information services, John L. Jones, discusses computer usage and outlook, as he sees it for Southern.

Q. What will the third generation of computers mean to the Southern?

A. The third generation to us is an extension of capability; it in no way represents a revolutionary change as far as we're concerned. It's an evolutionary change which gives us the capability of doing some things that, in some cases, we already knew how to do but simply did not have the capacity to do. As for configuration of the hardware, it is identical in concept to the second generation. Now, the reason we put in these third generation machines later than many other companies is, first, when we put in second generation equipment, we expected it to last us for five years, which it did, until about the end of 1968. The other reason is that we waited until the hardware and software was working very satisfactorily. Now we have made the conversion in a very simple way. We had some 2500 programs plus the big real-time system to convert. We used half the programming staff for six months to make this conversion, a feat possible only because all of our programs, including one real-time program, are written in COBOL. These computers (we have two each IBM 360 model 50 and 65, all linked together) are expandable, but we have purchased the basic electronic hardware for 8 to 10 years.

Q. What can your department do to help improve the day to day operations of the railroad—in the area of terminal delays, for example?

A. The area of operations is, in fact, the big area in the next decade in which there's going to be a fantastic revolution in the ability of the computer to help. During the late 50's and in the 1960's, the computer was used largely to become very refined in the accounting areas and so on. Despite the fact that everybody talks about how wonderfully well they're doing with their computers in operations, the fact is that the industry has barely, if at all, scratched the surface of what can be done. We do things like each morning produce delay reports which tell the operating departments which cars of



LIGHT PEN INPUT to computer is used by SOU. Unit is behind J. L. Jones.

MANAGEMENT INFORMATION

Like most techniques, our approach did not materialize overnight with instant success. This must be an evolutionary development of management technique and style based upon good and bad experiences over time.

Even though top management participation has become a cliche, the concept represented is essential to success. The corporate data resource is not departmental in nature and cannot be organized, managed and controlled as though it is. It is vital that this be understood to be a corporate problem.

It is important that the system and computer activities have freedom to work on the problem, not the politics, and have freedom to suggest good corporate solutions, not parochial departmental solutions. However, it is just as important that these people understand and support the corporate objectives and goals and not just be technicians. In other words, the systems and computer activity must be managed and not just administered.

The data capturing and recording must be the fewest number of the simplest things whenever the human is involved.

There must be discipline. Not just with the poor clerk who makes an error, but also with the programmer who makes changes for the sake of convenience (his or a friend's!) or efficiency, but causes control of data files to be lost or jeopardized.

which types have been in which terminals for how long. We have in fact, substantially reduced delays and when I say we, I am talking about the company, because the computer people don't do anything other than give operating people the data with which, hopefully, they can, for example, reduce delays.

But what we really want to do with the computer is what we're getting into now. For example, our computer is keeping dynamic inventories of 89 terminals on our railroad. And every time any traffic moves in or out of that terminal for any reason—not just trains, but interchange, industry, repair track, rail/highway, etc., whatever moves in or out—the computer instantly updates the inventory of the cars, at that place. And for each car it knows what type of car it is, it knows whether it's empty or loaded, its weight, when it came in, and it further has a code appended to it which tells what train or trains that car should move out on, what block in that train etc. Now this allows us to do things like this: The operating people will type in and ask, "What is the tonnage at Knoxville?" The computer replies that there are so many tons for Chattanooga, so many Chattanooga shorts, so many for the Maryville local, and so many for Atlanta and south. Or they might ask, "how many empty covered hoppers, are there, how many locomotives, how many cabooses, how many wood racks?" We're doing this now. But in addition to that we think we can provide the kind of information where, for example, the inquiry is: "Tell me all the cars of a certain category that have been in the terminal longer than so many hours. Or tells me are there any cars that should have gone out on train so and so but didn't?" I don't think we really know yet all of the questions the operating people want to ask; I don't think they really know. But I think the computer is really going to be brought to bear on this question of evaluating alternatives and then policing the actual field of operations.

Q. Will this be an effective means of increasing car supply?

A. Yes, and not just through eliminating terminal delay, but also we are slowly learning how to do a better job distributing cars. Most of our general service equipment, for example, moves under what we call flow rules. We've done origin and destination studies and we know what areas are chronic surplus areas for particular types of cars and what areas are chronic deficit areas. Then we devise a bunch of rules which say, all right, if you're in Meridian, Miss., and you get an empty 50-ft box

```
R 123A TON
E
    04-09-70  0601A   TONNAGE AT KNOXVILLE, TENN.        123A    0550A

            DIRECTION              LOADS      EMPTYS        TONS

          INDUSTRY                   60         187
          INTERCHANGE                 1          10
          WR LOCAL                    6          26         993
          MARYVILLE LOCAL            10           6         908
          MASCOT-JEFF CITY            1          84       2,002
          CHATTANOOGA LOCAL           7           2         541
          MIDDLESBORO LOCAL           9                     631
          BULLS-GAP                  98          67      10,938
          BRISTOL AND SHORTS         46          23       3,622
          CHATTANOOGA                45          68       4,848
          CHATTANOOGA SHORTS          2          15         484
          ATLANTA                    23          14       2,326
          LOUISVILLE                  2          15         504
          EAST ST LOUIS               8          37       1,433
          CINCINNATI                 24          27       2,396
          DANVILLE                    2                     115
          CHARLOTTE                  66           6       5,743
          HAYNE                      19          14       2,106
          SPENCER                    55          10       4,110
          SALISBURY SHORTS           66           8       5,419
          ASHEVILLE                  54           3       4,794
          RIVER LINE SHORTS           3                     282
          MURPHY LINE                50           6       4,847
          TONNAGE TOTALS            657         628      59,042

            LATEST TRAIN       PREVIOUS TRAIN    INDUSTRY-INTERCHANGE

    IN   02242 04-09 0130A  22345 04-09 0128A    IND  04-09 0130A
    OUT  02142 04-09 0630A  03045 04-09 0435A    INT  04-09 0345A

SOU RWY - PLEASE CALL AGAIN
```

KNOXVILLE TONNAGE REPORT shows train processed at 6:01 to leave at 6:30 a.m.

car and that's a surplus area, and we don't directly connect with the owning line at this place, and you don't have a load for it within the next 24 hours, route it to Birmingham, which is a chronic shortage area.

Every morning, the car distributor for 50-ft box cars, gets a computer-produced report that says, at these pooling points you have so many on hand, so many expected today, so many expected tomorrow, so many expected day after tomorrow. Now with that report, and with his knowledge of the business, he can make the fine tuning adjustments. He can call these various agency points and adjust the flow rules to put supply where the demand is.

I view that as a very crude way of distributing cars, although it is much more effective than some of the older schemes. I don't think anyone would say that this is a sophisticated scheme that cannot be improved upon. But having these flow rules does get the bulk of the cars moving right. And since we have rules, the computer can police them every morning and put out a report saying, this area held these cars but did not have a load within 24 hours. Then the car distributor can see why the rules were not enforced. So in addition to improving the efficiency and effectiveness with which we move cars, we will also devise ways for better car distribution. Now, I don't happen to be of the school that says that in the very near future we are going to have the computer saying,—send car 12345 to this shipper and send 54321 to that shipper, etc. We may be able to distribute specific cars to specific shippers some day but there are tremendous problems. For example, you have to know a lot about the condition of the car and cleanliness—we don't have a good enough classification system.

Q. Isn't this the ultimate goal of the TRAIN system of the AAR?

A. The TRAIN system only deals, currently, with interchanges of cars. It knows essentially by railroad the location of the car. It doesn't seem to me there is any hope, at least in the foreseeable future, that a large single central computing center could keep track of all the cars with anywhere near the timeliness and accuracy that the individual railroad can. It's a data discipline problem. No matter how big and how fast and how fancy your computers are, there's two things your data has got to have—one is accuracy, the other is timeliness. The computer can't help you with that. If you give it to the computer and it's four hours too late,

the computer can process it in a few millionths of a second and now it's four hours and a few millions of a second too late. If it's inaccurate—well, the only good thing you can do with bad data is throw it away. So those two things have to be accomplished. And you only add one more difficult layer when you try to bring this into a national cycle. Even with our ability to exercise discipline right on our railroad it's still a 24-hour-a-day, 7-day-a-week continuous job to keep this data arriving in an accurate and timely fashion.

Q. Are you suggesting that TRAIN may not be very valuable, after all?

A. No, it definitely has place in the scheme of things. It certainly has potential in terms of helping national distribution of car fleets. Right now when a car goes off our line we don't know, sometimes within 10 days or two weeks where that car is when we try to get it back. That's because the junction records of carriers are that far behind, TRAIN certainly can be effective there. There are many things that the TRAIN system can do. But there are limitations. The TRAIN computer is a 360 model 40. We don't use such a small computer for processing. We've got two 50's and two 65's to do our Southern Railway job. I'm just trying to point out the magnitude of the problem we're talking about.

Q. How about operations simulation?

A. We have two kinds of simulation that we have used fairly extensively. One of them is the so-called train performance calculator. Given certain locomotive characteristics, and knowing the terrain—all the grades, curves, etc.—and given the load distribution, the train performance calculator can predict minimum running times, fuel consumption, drawbar pulls, the effect of speed restrictions, and this kind of thing. We've used this simulator quite extensively—to some extent to evaluate line changes, we've used it in some train length studies, and this is one of the things that caused us to reduce train sizes. We've used it in setting tonnage ratings, and we've used it to solve particular problems. A trainmaster will call and say "I'm having a problem with this train getting down this grade. I'm trying to use dynamic braking—what would happen if we applied it at Point A instead of Point B?" The simulator is by no means perfect, but it gets better and better as you use it and get more confidence.

The other area of simulation we have used fairly extensively is treating the railroad like a network model, looking at it on a system-wide basis. The fundamental value of such a model is to allow you to evaluate the effect of train service changes. I want to point out that the state of the art of simulation is such that it is not an optimizing situation, contrary to much popular opinion. The present state of the art gives you the ability to evaluate specified alternatives. We are in the midst of rewriting, redesigning this simulation model. When this is completed, in the fall of this year, we will have quite a sophisticated model. What we really want to do is get to the point where we can answer such questions from the operating department as "What would happen if I ran an extra train from Atlanta to Chattanooga? Will that help my yard congestion in Atlanta, or does that just move the problem to Chattanooga? Or does it make no difference at all, because that's really not the problem?" I think we will get to the point where we can answer these questions in three to six years.

Q. What will the computer center be doing for the railroad five years from now that it is not doing today?

A. Simulation is one thing—and we will learn much more about car and locomotive distribution. It will give us the capability to have more centralized control over such functions as dispatching and CTC. I would be surprised if there were not some tie-in between humpyard computers as time goes on where, if ACI ever does work—and that's not for sure—you ought to be able to have a scanner sitting out there recording the fact that the train is now 30 miles from the yard and the cars that are in fact on this train, and through the local computer at the yard, plus the central computer, have the switch list or the hump list or whatever available when the train comes in. We're looking at yard simulation to try and evaluate better ways of operating yards.

I also think that we're now going to start to see some interchange of data between railroads. Illinois Central, for example, has recently said they'd like to work with us on this. I'm talking about where we originate a load of traffic in Atlanta and we're going to haul it to Birmingham and give it to the IC. The ridiculous thing that happens now is this: When we get that carload we carefully type that information into the computer—and we correct it and keep monitoring it. Then all of a sudden one day at 11:59 p.m. the cars appear on an interchange track for the IC in Birmingham—and the same thing starts all over again; and maybe all over again, when the IC turns it over to another railroad. Now that's pretty stupid.

When we get the information, we ought to store up all of the information that relates to the IC and allow the IC computer to call us once or more a day and say, "What have you got since I called you last time?" And at that point, on a computer-to-computer basis, we give them all the waybill information that concerns them, and as time goes on even an estimate of when that car is going to arrive in Birmingham. Now they can start doing some planning. We're talking, really, about reserving spaces on freight trains just like you reserve space on airlines. But we need a reservation information system, first. When you walk up to Delta Airlines in Atlanta and want to fly to Chicago and connect on Northwest to Seattle, you don't have to go to two or three different places.

Q. What can computers do to help marketing and sales?

A. We have had for quite some time a sophisticated market analysis program. Of course, we are able to produce the standard reports. We know, for example, exactly who our top customers are, in what order, how much they ship and how much they receive. We make commodity analyses, and return-on-investment analyses on assigned pools and by ownership type, etc. The computer can go through consolidated history tapes and pick out commodities that have changed from the first quarter 1969 to the first quarter 1970, and then do a very sophisticated analysis as to what caused that change. What was the effect of a changed length of haul, of a rate change, of heavier loading. This allows us to evaluate the results of something we have done, such as an incentive rate; to see if we really get a longer haul, if we really get a heavier loading, if we really make more money. And it lets us detect those places where we should do something—where a commodity is slowly starting to slide off. We further have the ability to analyze the contribution of each commodity to car revenue which allows us to determine when to flag items for hold back in rate increase citations. We have an extensive sales package which traces business back to individual representatives. It is quite a sophisticated revenue, marketing and sales analysis package.

We have tried to foster the attitude, among our computer people, that we are not a bunch of bright young folks who are going to come in here and try to tell everybody else how to run his job. We are merely supporting members of the team with some specialized skills—people who can help businessmen identify and solve their problems by working together with them.

SOUTHERN EDP

SOU management involved in EDP

Southern's approach to computer management was discussed by John L. Jones, vice-president management information services department, Southern Railway, at American Management Association's 16th annual EDP conference, Feb. 24, 1970. Excepts from his talk follow:

Any useful data must be accurate and timely. Too often we act as though these are separable characteristics—e.g., accounting data must be accurate and real-time data must be timely. This unfortunately results in the situation where accounting reports and products are accurate but too late to be useful and real-time data is timely—if only it were 100% dependable as to correctness. Neither of these characteristics can be overlooked.

There is an obvious principle here relating to the human capturing the data—such a person should do the fewest number of the simplest things! A corollary of this principle is that one should concentrate the necessarily complicated parts of the data capture process into one or very few points where control can be exercised. This minimizes training requirements. It also results in continuing pressure on the programming staff to develop and refine computer edits and support since the problems are concentrated at one or very few points and can easily be identified.

We have about 300 reporting locations scattered over 13 states. We went to a data capture system using Long Distance Xerography for facsimile transmission of waybill data at high volume locations. We effectively can transmit copies to Atlanta from field locations at 10 to 11 pages per minute. At low volume points we use the telephone.

These techniques minimize—virtually eliminate the need for field training. Any format or data imput terminal changes are made unnoticed by the field. Very few (35) on-line data input terminals are required and the problem of manning of these centrally-located machines with highly qualified and trained typists for 24-hour, 7-day coverage is greatly simplified. All the difficult problems are centralized in one room in Atlanta.

The fundamental concepts of data base integration are: (1) data should be stored in duplicate form in as few places as possible and (2) maintenance performed on the data at any one place should properly and automatically be applied to any other place or places data may be affected.

As soon as one begins to explore the impact of this concept, he normally finds very quickly that he has involved himself in interdepartmental matters—sometimes called class knowledge. Class knowledge is that knowledge an individual or department has which is not defined, is acquired only through the osmosis of long association and experience. To give an example—a lot of organizations in our company are interested in a freight car—all from a different point of view:

(1) As a capital asset; (2) as an item to be maintained; (3) as a taxable item to be depreciated; (4) as an item to be insured; (5) as a revenue producing item when loaded; (6) as a commodity to be sold when empty; (7) as a rental item when used on other railroads; and (8) as a distribution problem to match and move to the next load.

We discovered each of these organizations had its own lists of the identifications and characteristics of our cars. To get such a diversity of organizations to cooperate enthusiastically in developing and maintaining a single consolidated register of equipment is not straight forward. To a large extent this is because each organization believes its own list is correct and can't see any particular benefit to itself for all the work required to correct everybody else's.

Management understanding

Top management involvement in systems and computer related activities means top management provides the environment which fosters mutual understanding and coordination between itself and the corporate systems and computer activities. It requires a lot of personal time and attention on the part of the executives involved—time spent listening and learning as well as teaching the computer people what it is the company is trying to accomplish.

At Southern, every request for new computer products is reviewed by the major department heads—the vice-presidents. Anyone can initiate a request for computer services which is coordinated through his department representative. The request is evaluated by the data processing staff as to feasibility, practicality, man-days required to implement, computer time to process and print, and elapsed time. The request is then sent to the department heads. Each one can vote to approve, reject or call a hearing on any request. Unanimous approval is required. A reject vote is final unless the requestor appeals to the department heads for a hearing. A hearing vote causes the requestor to appear at the next regular monthly meeting of the department heads, which the president normally attends, and answer whatever questions need to be answered.

This practice has had a tremendous two-way effect. Since everybody at Southern works for some department head, very few frivolous or poorly thought out requests surface for a vote. The educational effect, both as to the use of the computer and the needs of other departments, on the various department heads has been excellent. The decisions become corporate decisions, not departmental, and the normal priority conflict does not exist. Further, the computer activity is operated under this broad policy guidance with complete freedom to do the work in what ever manner is best—without continual defensive maneuvering to explain, defend and justify its existence. Also, without charge-back of costs to the various departments.

In this environment, when we decide to do something like create a master register of our equipment, it is not a computer decision—it is a corporate decision; and the word goes out. While I wouldn't say the problems all disappear, at least they are not the result of unsure and insecure leadership on the part of the department heads wondering what's going on and why, or who's trying to foul them up or load more work on them—they already know! Furthermore, since you clearly must pick the most critical use of the data as the controlling factor in its establishment and maintenance, the department heads and their people come to understand why all changes must funnel through one place, and why certain controls and audits must be met, and why you can't maintain the pieces of the data base (which may physically be on several different tape files) independently of the process to which it is locked, etc.

It should be made clear that we have objectives and goals as well as fairly definitive plans of attack and project control. My point is that we do not waste our energies in defining to great levels of detail.

Product News

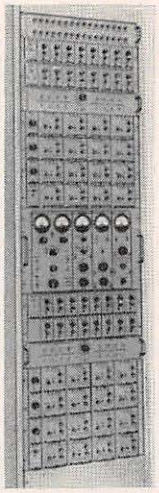
Acoustical data sets work with printers (101)

Four new DigiNet acoustically-coupled data sets are the TDM-114 and TDM-115 series. A twofold handset/modem mating device locks the telephone receiver into the DigiNet modem for positive telephone coupling and more reliable signal transmission. A spring-loaded clamp holds the handset firmly and prevents uncoupling. Twistlock action automatically activates the DigiNet data set when the locking arm is swung into place. New acoustic seals with softer cushions provide better contour compliance for all typical ("500" type) telephone handsets. They improve signal-to-noise ratio to provide more accurate digital communication.

The new clamp arrangement also provides 4-5-lb pressure at the matching interface between the handset and acoustic seals on the data set. This reduces ambient noise pick-up and vibration, resulting in less signal interference. A carrier detector light, added on the front panel, indicates signal presence and quality without removing the handset from the modem cradle. The light remains "on" if the signal is moderate or strong. It flickers when signal strength is marginal. The light goes "off" upon call disconnect or in the absence of an adequate signal.

The new DigiNet modems have two-level selectable transmitter output. A high output level is selected when received data signals are sufficiently strong to provide a high signal-to-noise ratio. This selection increases communications accuracy and improves error rate. The lower level may be selected when received signals are weak on the telephone line. This reduces errors caused by second harmonic interference. Offered with optional lightweight plastic carrying cases for added portability, General Electric's DigiNet TDM-114 and TDM-115 acoustic data sets operate with most teletypewriters and business machines over private lines or switched telephone networks.

These units comply with tariffs covering use of acoustic couplers on the switched network. The units are compatible with Western Electric 102A2 and General Electric's TDM-110 and TDM-111 data sets. The new sets measure 4" high, 7½" wide and 9" deep. The TDM-114 originate only models weigh 6 lb, and the TDM-115 originate/answer models weigh 7 lb. *General Electric Telecommunications Products Department.*



Telegraph terminal has 16-channel capacity (102)

The type 7230A telegraph terminal is a solid-state 16-channel full duplex frequency division multiplex system for telegraph data over microwave or wire lines. All channels have digitally keyed audiotone FS signaling that can be independently operated. The system utilizes a building block technique to provide non-diversity operation or dual and fourth-order diversity operational capability. Equipment fits 19" racks. Although the telegraph terminal is primarily operated with a companion distant terminal, it may be operated with any voice frequency multiplex terminal having compatible channel frequency allocations. All transmit and receive modules are self-contained including an internal power supply. *Tele-Dynamics.*

Filter units convert 4-wire to 2-wire (103)

Filter assemblies are used to convert cable carrier systems from four-wire to two-wire operation. A new product bulletin describes the directional filter assemblies 4DFO1A/4DFO2A and 4DFO3A. *Lynch Communication Systems Inc.*

Battery chargers have filter units (104)

A complete line of solid-state battery chargers, including filtered units for communications applications which require ripple-free DC, is described in a new bulletin. Units are available for 12, 24, 48, 120 and 240-volt systems, and range in capacity from 3 amp output to 400 amp output.

The battery chargers are designed for float service for both nickel cadmium and lead-acid batteries, with or without a connected load. The bulletin includes complete specifications, principles of operation, electrical schematics for both standard and filtered charges, and case dimensions. A full list of optional equipment is also included. *NIFE Incorporated.*

Brush cutter works in rugged terrain (105)

A rubber-tired brush cutter can cut brush and trees up to 3-4" in diameter. Two flail-type cutter heads are separately powered hydraulically to cut heavy brush. The two cutters, each with four blades, can cut a 7-ft swath, and are fully reversible. Also, the cutter assembly can be raised for a 45 deg approach angle. The brush cutter has 4-wheel drive, and can operate at speeds of 0.5 to 16 mph. The unit has a ground clearance of 18". An optional attachment allows the whole cutter assembly to be turned left or right 20 deg in a horizontal plane for wind rowing effect. *Kershaw Manufacturing Co., Inc.*

A simplified look at how T-carrier works and what it does for railroad communications

HOW IT WORKS

STROMBERG-CARLSON T-Carrier System employs pulse code modulated (PCM) carrier techniques to carry 24 high-quality voice channels over two telephone cable pairs.

Pulse code modulation means, in the simplest terms, giving a series of pulses the job of carrying the description of a minute portion or sample of a telephone signal from one point to another. Then, by sending descriptions of enough portions or samples of the signal, the signal can be reproduced at the distant end. A carrier system using pulse code modulation converts these telephone signals into series of pulses for transmission over wire, then reconstructs the signals at the distant end to provide a more efficient communications channel. How this is done is quite easy to understand and is well within the state-of-the-art in this age of microsecond electronic operations.

First, information theory tells the communications engineer how many samples of a signal must be described to the receiving carrier terminal by the transmitting terminal in order for the signal to be reproduced faithfully. In telephone conversations, if we take a sample each 125 millionths of a second, we get a faithful reproduction. So each 125 microseconds the sending terminal measures the size, or amplitude, of the signal at that instant. This amplitude measurement is the description of the sample of the signal.

The second step in the operation of a pulse code modulation carrier system involves a fact that may seem impossible, but it is proven by performance to be true. This fact is that one of 127 amplitude descriptions will adequately describe any sample of a telephone signal. If each of these 127 descriptions could then be transmitted from one carrier terminal to another, any signal could be reproduced at the distant end.

To get these 127 amplitude descriptions into a form which can be transmitted, a code has been devised which provides us with 127 identifiable series of pulses something like those created by operation of an ordinary telephone dial.

So, the sending terminal assigns one of the 127 codes of pulses which best describes the portion or sample of the signal obtained in the first phase of operation.

The next step in PCM carrier operation is the conversion of the assigned code from direct-current pulses to a more convenient and efficient alternating-current signal to carry it over regular telephone facilities. This step is only incidental to the pulse code modulation method, because in the next step, at the receiving terminal, the alternating-current signal is simply converted back to direct-current series of pulses which describes the sample of signal originally taken.

The last step, then, is the recognition by the receiving terminal of the code assigned to the sample of the signal and the emission of its identical twin, which it obtains from its vocabulary of 127 signals. The signal is thus electrically reproduced and ready for an acoustical device such as a telephone receiver.

But, of course, not enough would be gained if only one conversation were sampled for transmission in this manner. In the first phase of operation, we are told that a conversation must be sampled every 125 microseconds—so between the times the system samples this first conversation it has time to sample others. In the STROMBERG-CARLSON T system, it has time to sample 23 other conversations and send

the information on. Since the terminals are locked in synchronism, the channels are always kept in their proper order.

BENEFITS OF PCM CARRIER

There are several 24-channel cable carrier systems using **F**requency **D**ivision **M**odulation. What does PCM offer over FDM?

Protection of Signal from Noise and Distortion

Noise and distortion have greatly reduced effect on PCM. Since these disturbances can enter the FDM system along the line, they are amplified at repeaters and result in some form of disturbance in the user's ear. In PCM, it's simple: once the sound portion is coded, only rare disturbances can upset this coding. The PCM codes will, therefore, go through unaltered and be reproduced. The principal sources of signal distortion in FDM systems are the repeaters along the line, particularly during heavy traffic. In PCM, only the pulse is being repeated; there is nothing to distort.

Highest Immunity to Crosstalk Brings Higher Percentage of Cable Fill

Limitations on cable fill are a product of crosstalk. The crosstalk problem, which is common to FDM systems, is reduced by PCM techniques. PCM recognizes only signals above a certain strength. Repeating and decoding are done before pulses fall below the recognition level. Crosstalk is simply blocked out. The result is more efficient utilization of pairs in each cable.

Unmatched Data Transmission

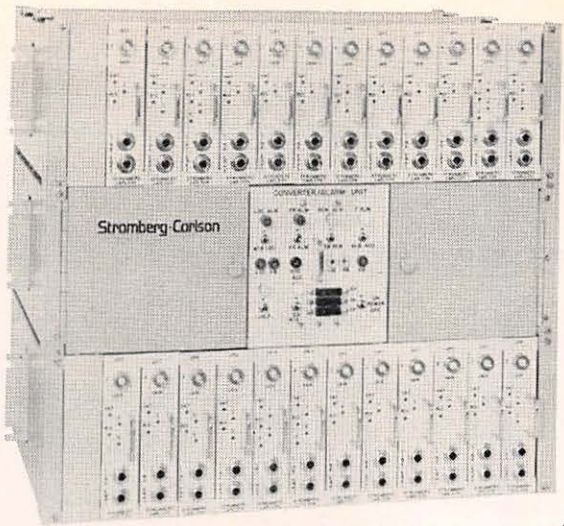
All 24 channels can be fully loaded with data in both directions without sacrificing quality. In a system with 23 channels loaded with data, the 24th channel can carry voice with no degradation of quality.

BENEFITS OF STROMBERG-CARLSON DESIGN TO RAILROAD COMMUNICATIONS

The STROMBERG-CARLSON T design uses the very latest proven electrical and mechanical design techniques and gives the user these advantages:

Built-in Troubleshooter

Our system automatically monitors for the spurious signals. Determination of whether the trouble is in the incoming or outgoing line signal is immediate. Since there is no need for special test equipment to make this determination, there is no interruption of service. When a problem occurs, a spare span



can be patched in at once. There is no question about its being operational, since our detection system monitors this circuit. Automatic error detection which provides this very valuable feature is standard in the STROMBERG-CARLSON T-1 system.

Rapid Expansion without Service Interruption

Terminals need not be fully equipped with channel units. Plug-in channel units can be added, removed, or changed at any time without interrupting service on other channels. Each repeater case holds up to 24 two-way repeaters (for 576 two-way channels). Adding repeaters is simple, quick, and inexpensive.

Repeater Interrogated from Central Office

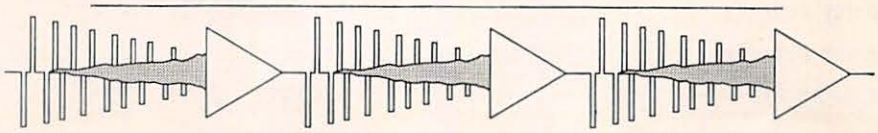
Repeaters for the system are powered over the physical. The operating condition of the repeaters can be verified from either terminal by built-in interrogation equipment.

Saves Expensive Floor Space

Each basic 24-channel terminal requires only 15¾ inches of vertical space on a standard 19-inch equipment rack. Eight complete terminals (192 channels) can be mounted on one standard 11'6" rack; six terminals mount on a 9' rack.

Lower Installation Cost

Each basic 24-channel terminal assembly is completely wired and tested before it is shipped. Only an external drop, power, and line connections are required.



Symbol represents voice signals with noise and crosstalk as rough overlay.

The symbol represents voice signals being transmitted on Stromberg-Carlson T-1 Carrier as a bipolar, binary train of pulses, with noise and crosstalk as a rough edge overlay. The pulses are attenuated as they travel the cable pair to the first repeater while noise and crosstalk are increasing. The repeater recognizes and regenerates the pulses, virtually eliminating noise and crosstalk, and the process is repeated.

TRANSMISSION PRODUCTS FOR OPEN-WIRE USE

S-C 761 Party Line Carrier: a transistorized medium-haul three- or four-channel system that can reduce load on message circuits by as much as 75%. The system upgrades way stations operating with 35-40 parties per line to only 10 or fewer parties per line. For additional efficiency and economy, the 761 is convertible to our 765 Trunk Carrier System.

S-C 661 Party Line Carrier: a 12-channel stackable double-sideband system that provides one to 12 full-duplex voice channels on a single VF telephone circuit. Each channel can serve up to 10 parties, with selective ringing of each. Choice of plug-in cards provides bridged, divided, or superimposed ringing.

For complete information on any of these communication systems, call Jim Codd at (716) 482-2200. Or write Railroad Division, Stromberg-Carlson, 100 Carlson Road, Rochester, N. Y. 14603.

Stromberg-Carlson

A Subsidiary of General Dynamics

Circle 12 on reader service card

Data Sheet

187

DATA MODEM CHARACTERISTICS

Manufacturer	RFL Industries	RFL Industries
Model	4000	3227
Transmit and/or receive	Transmit & receive	Transmit & receive
Full and/or half duplex	Full on 4 wire	Full on 4 wire
	Half on 2 wire	Half on 2 wire
Dial up or private line application	Private line	Private line
Turn around time (HDX)	25 ms	15 ms
Automatic answer capability	No	No
Type modulation	Synchronous FSK	FSK: Coherent clock & data
Operating frequencies	1700 ±600 Hz	1700 ±600 Hz
Clock, internal or external	Internal	Internal
Loop back testing feature	Optional	Optional
Error rate	—	—
Error detection and/or correction	None	None
EIA RS-232-B interface	Available	Available
Bit or character rate	1200 (or 1800) bits/sec	Up to 1000 bits/sec
Serial or parallel transmission	Serial	Serial
Impedance to line, ohms	600	600
Impedance to data equipment, ohms	RS-232-B or DTL	RS-232-B or DTL
Voltages to and from data equipment	RS-232-B or DTL	RS-232-B or DTL
Frequency stability	2.5% from −30 to +70 deg C	2.5% from −30 to +70 deg C
Level stability	1.5dBm from −30 to +70 deg C	1.5dBm from −30 to +70 deg C
Output levels to line, dbm	−30 dBm to +2dBm	−30dBm to +2dBm
Input levels from line, dbm	+6 to −45dBm	+6 to −45 dBm
Line requirements, frequency response	3002, C1 cond.	3002, C1 cond.
Line requirements, envelope delay	3002, C1 cond.	3002, C1 cond.
Line requirements, impedance	3002, C1 cond.	3002, C1 cond.
Line requirements, signal to steady noise	3002, C1 cond.	3002, C1 cond.
Line requirements, signal to impulse noise	3002, C1 cond.	3002, C1 cond.
Method of operation	2 or 4 wire	2 or 4 wire
Temperature and humidity limits	−30 to +70 deg C	−30 to +70 deg C
Power requirements	115/230 volts, 50/60 Hz	115/230 volts, 50/60 Hz
	25 watts	25 watts
Dimensions and weight	Rack: 19" x 3.5" x 8"	Same
	Desk: 18" x 4¾" x 9⅞"	
	20 lb	
Digital or analog	Digital	Digital

You can shop by postcard in

Railway System Controls

HELP YOURSELF . . . to the wide variety of manufacturers' literature shown on the preceding pages. You don't have to write, just circle the numbers on the card below. Then drop the card in the mail (no stamp needed). Railway System Controls will forward your request to each manufacturer and he'll send you complete data free of charge. So . . . get out your pencil and help yourself.

RAILWAY SYSTEM CONTROLS • Reader Service Card

THIS COUPON SERVICEABLE FOR 90 DAYS AFTER DATE OF THIS ISSUE

Circle numbers for more information about products and services.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
24	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**
47	**48**	**49**	**50**	**51**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**
119	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**135**	**136**	**137**	**138**	**139**	**140**	**141**
142	**143**	**144**	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**	**153**	**154**	**155**	**156**	**157**	**158**	**159**	**160**				

NAME .....

TITLE .....

RAILROAD .....

ADDRESS .....

CITY ..... STATE ..... ZIP # .....

Reader Service Card

Help yourself to information about products, literature and supplies in the signaling, controls and communications areas. Fill out the other side of the card below, tear it out and mail. It's your Railway System Controls shopping guide.

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY MAIL

First Class Permit No. 31775, Chicago, Illinois

RAILWAY SYSTEM CONTROLS

29 EAST MADISON STREET

CHICAGO, ILLINOIS 60602

ATTN: R. W. McKNIGHT

NEWS BRIEFS

(Continued from page 11)

advantage of this system as presently contemplated is that it assures that the rider travels only the distance that he pays for with a minimum of manual supervision.

"For this new system, the automatic fare collection equipment is so designed that it could be tied to a computer which would develop data indicating the origins and destinations of every ride on the system," he explained.

"This type of data is the basic information required for the development of schedules for a transit system. Until now, such data has been obtained by having men standing on platforms and estimating rider volumes."

Gaul reported that the Baltimore Transit Company is "probably the most advanced" in the use of the computer for scheduling and related purposes.

"In Baltimore, a computer is used to perform a number of scheduling and manpower assignment tasks," he explained. "The more significant advantages gained by the Baltimore Transit Company are the speed with which new schedules can be prepared and the accuracy with which they are produced."

Gaul concluded by emphasizing that the transit industry "recognizes the value of the computer and is moving forward to adopt it in every way possible."

New equipment and techniques discussed

Integrated circuits, new solid state controls, and use of audio frequency track circuits will be featured topics at the eastern sectional meeting of the Communication & Signal Section AAR, at the Netherland Hilton Hotel in Cincinnati, Ohio, May 21. Keynote address will be presented by D. D. Strench, vice president operation, Louisville & Nashville.

Development and manufacture of micro-miniature integrated circuits will be discussed by James A. Smith, planning engineer, Western Electric. Track circuit fundamentals will be the topic of discussion by A. J. Carey, manager railroad control, Signal & Communications Div., WABCO. A new solid state hot box detector featuring rail mounted scanners will be discussed by C. A. Gallagher, manager application engineering, Servo Corp. of America.

The afternoon session will lead off with a discussion of the problems and techniques in the use of audio track circuit systems by A. L. Stevenson, vice president, engineering and tests, Harmon Electronics Inc. Space radio locomotive control will be discussed by staff engineers of Motorola Communciations and Electronics Inc. Application of motion sensor equipment for highway crossing controls will be the featured topic of a paper by Robert T. Sewell, manager application engineering and field service, Marquardt Industrial Products Co.

Automated subway passes 12-month operating mark

The 14-mile Victoria line of the London Transport in Great Britain has now been in full service for one year. Train running and bringing a train to a station stop are automatically controlled once the operator has pressed the starting buttons after the doors are closed.

"The results of the full automation have been proved by the greater regularity of the train service under conditions of 25 to 30% higher speeds; after a minor delay, too (say, passengers holding doors), the service is found to pick up more readily than on manually-controlled lines," said F. G. Maxwell, London Transport Executive, speaking to the Institution of Railway Signal Engineers in February. The following material is adstracted from his talk.

In the off-peaks, the regulating room can switch the whole line to "coasting" at the approach to stations, with considerable savings in current, while, when heavy traffics are causing long station stops, "coasting" can be cut out and trains run to braking spots under full power. Arising from successful experience with this, a development is shortly to be tried which will enable selective coasting to be switched in automatically by the program machines. In this way an individual train, which may have lost time, will be able to be speeded up to close an interval, without the whole of the trains on the line being similarly treated.

The signaling by feeding coded impulses into the track circuits have proved increasingly reliable. In the last six months, the rate of failures causing delays of two minutes and over has come down from 1.30 per 10,000 train-miles per week to 0.35.

There are, however, only two coded speed limits in use—420 code which allows a maximum speed of 58 mph (in practice controlled by the auto-drive equipment to hold the train at a maximum of 48 mph) and 180/270 code, which allows a maximum speed of 25 mph. In junction approach areas, where the 48 mph cannot be accepted, there can be an appearance of a long run-in at less than half speed. In developments on future automatic lines, it will be worth considering whether a third coded speed, perhaps 50-35-20, might be economically justifiable, particularly if the line is longer in end-to-end operation than the Victoria Line, or has longer stop-to-stop distances.

The "Identra" system has been introduced to enable each individual Train Operator to describe his own train's destination for each trip; this information appears on the platform destination indicators as well as in the Regulator's diagram. The system has worked surprisingly well and there have only been 16 failures of the apparatus since the line was fully opened in March, 1969. Future development of the system may well enable the set working number of each train to be positively identified by some train-carried coil, instead of the Regulator having to rely on the program machine prediction of the number of the next timetabled train.

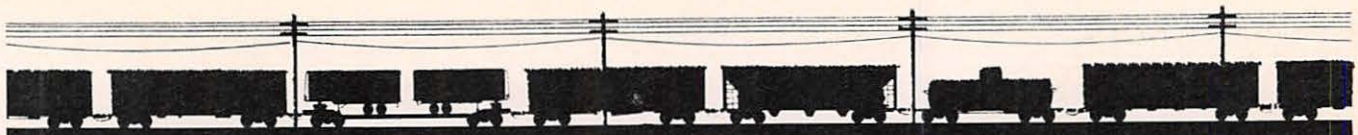
The closed circuit television installation has also been found of great value. The Train Operator gets a "guards-eye" view of the platform at the rear of the train and the monitors in the Control and Regulating Room give the Traffic Controller both real and psychological help. The Controller, for the first time, sees the traffic; he can gauge whether it is building up sufficiently seriously to justify turning a train to fill a gap in the service. When a train is held for a defect, the Controller can often see whether the station staff have the matter in hand; this can avoid telephone calls, which would drag a key man away from dealing with an incident. It is also a useful deterrent to vandalism.

After modification of the e.h.t. line transformer the television installation has worked well. The camera tubes, at $120 each, are an expensive item; but it is hoped to push the life of these up to six months in continuous use, from their present guaranteed life of three months.

Perhaps the most satisfactory result of the first year's operation on the Victoria Line is seen when we look at the effect on the staff.

Before automation was introduced to this extent, a lot of study was made into the human reactions involved. When the natural fear of "Is this going to do me out of my livelihood?" had been accepted, after considerable Trade Union discussion, as being nothing but a bogey, there still re-

(Please turn to page 37)



Only One Cable Manufacturer makes this

Total Commitment to the Railroad and Fixed Ground Transit Industries

1 Rigid quality control standards to provide assurance of the finest materials and workmanship . . . the highest degree of reliability.

2 Delivery schedules, set up to meet your requirements . . . and strictly maintained.

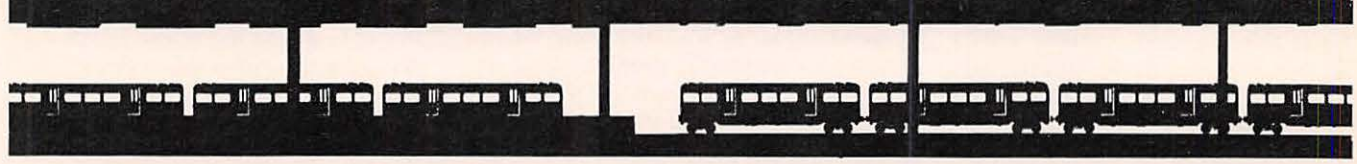
3 Products which satisfy virtually all of your cable requirements for communication, signal and control.

4 All personnel . . . at all levels . . . alerted to the obligation of this commitment.

5 Every agent selected for years of experience and reputation in serving the Railroad and Fixed Ground Transit Industries. (Please see the adjoining page.)

The Ansonia Wire & Cable Co

Ashton, Rhode Island 02864



Ansonia Agents Servicing The Transit Industry

■ National Accessories Company, Inc.
346 Suburban Station Building
1617 John F. Kennedy Boulevard
Philadelphia, Pennsylvania 19103
215-563-2603

■ Clawson Railway Supply
9322 Manchester Road
St. Louis, Missouri 63119
314-961-5533

■ Fitzhugh Railway Equipment Corp.
2500 West Broad Street
Broad Street Station
Richmond, Virginia 23220
703-358-7184

■ Howe-Stephens Company
1826 Industrial Way
Redwood City, California 94063
415-366-9591

■ Mikan-Hagerth Corporation
100 Church Street
New York, New York 10007
212-233-2286

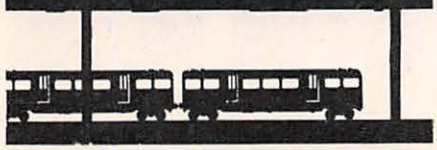
■ Modern Industries, Inc.
100 Outer Loop
P.O. Box 14287
Louisville, Kentucky 40214
502-361-1113

■ Edward Moriarity
7 Deerfield Lane
Huntington Station
Long Island, New York 11746
516-271-1252

■ B.W. Parsons Company
818 Pioneer Boulevard
St. Paul, Minnesota 55101
612-227-6511

■ Western-Cullen Division
Federal Sign & Signal Corp.
2700 W. 36th Place
Chicago, Illinois 60632
312-254-9600

The Ansonia Wire & Cable Co
Ashton, Rhode Island 02864



NEWS BRIEFS

(Continued from page 35)

mained the human feeling that a motorman or a signalman was proud of his skills and might resent handing them over to electronic wizardy. The job content of each phase of automated control was closely examined with medical advice.

Boredom has not so far obtruded itself on any front; Traffic Regulators and Train Operators seem to have developed a new pride in the ingenuity and newness of the equipment which they are monitoring; nor, as yet, have there been complaints of being overtaxed, when there is a change-over from all running smoothly to the concentration necessary when an emergency arises. This factor will, of course, have to continue to be watched as further automation proceeds.

If we can make a success of automation on every front and save routine-type manpower, there will be more underground lines constructed in London and better paid jobs for more railwaymen in total (if less men per station or per train).

Decade of Seventies sees more EDP usage

The full acceptance of cybernetics in railways and the development of full automation will come to fruition in the decade of the Seventies. Forecasts by prominent railway men were published in the January 1970 issue of *International Railway Journal*, a companion Simmons-Boardman publication. Abstracts from these forecasts follow:

Louis Armand, secretary general, International Union of Railways, said: "'In all these spheres cybernetics is a powerful tool but—and this is of greater significance—it will provide additional flexibility in operating conditions. This will be the case, notably, in the faster turnaround of wagons, in better train running thanks to improved signalling and, above all, in tariffs since computer will more easily calculate the charge in relation to the cost price of the operation."

"Railroads will meet the challenge with new computerized systems that will aid car utilization, efficiency and overall decision-making," said Thomas M. Goodfellow, president, AAR.

The future of urban transport was outlined by Andre J. Jacobs, general secretary, UITP, who said: "As one contemplates the future of rail rapid transit one has a vision of a tremendously smooth machine: silent, unmanned trains, running to computer programs, sweeping across the city and far out into the surrounding areas; automated ticket vending, automated money changing; automatic barriers and ticket control; escalators, moving sidewalks; the all-seeing eyes of television scanning the halls and platforms of unattended stations."

Computer programs will aid shippers-rrs

Manufacturers, distributors and other companies that ship goods by rail will be able to plan their shipments more efficiently with the help of two IBM computer programs, called Tariff Publishing System and Traffic Profile Analysis System. Together, they analyze computer-produced tariffs supplied by the railroad industry and print customized reports for planning shipments.

The first computer-generated tariffs have been filed with the Interstate Commerce Commission by the railroad industry's Traffic Committee on Data Services, Chicago. The tariff program was developed by IBM, and the Joint Railroad Tariff Computerization Committee during a cooperative study.

Tariff Publishing System will be used by the railroad industry's three regional tariff publishing bureaus in New York, Atlanta and Chicago to update freight tariffs and print the full tariff schedule. The bureaus also will provide railroads and shippers with tariff data on magnetic tape.

Tariff Publishing System enables the user to update his basic tariff data on magnetic tape and to print out selected information. The selected information is extracted by the Traffic Profile Analysis System, based on the shipper's description of his shipping requirements.

Both program products, written in assembler language, run on IBM system/360 model 25 or larger computers having at least 32,000 bytes of core storage. They are scheduled to be available in the third quarter of this year, under a license agreement. Monthly charge for Tariff Publishing System will be $200; for Traffic Profile Analysis System, $300.

Ansonia appoints sales representatives for U.S.

National Accessories Co., Inc., of Philadelphia, Pa., has been appointed exclusive agents for Ansonia Wire & Cable Co., servicing the railroads and fixed ground transit industries in the U.S., Canada and Mexico.

People

BESSEMER & LAKE ERIE: **Richard K. Anke** appointed systems designer, system, at Pittsburgh, and **James P. Bobich** appointed procedure analyst, systems, also at Pittsburgh. **Gerald E. Pears, Gregory W. Pierce, Joseph B. Hurt,** and **Richard G. Stanley** appointed quality control supervisors, data processing at Pittsburgh. **Robert E. Hobbs** appointed project supervisor, data processing, and **Robert C. Shurson, Jr.,** appointed general operations supervisor, data processing, both at Pittsburgh.

BURLINGTON NORTHERN: **C. H. Wesman,** formerly engineer of communications Great Northern, appointed assistant director communications for the Seattle and Portland regions, with headquarters at Seattle, Wash. **M. B. Walker,** formerly assistant signal engineer Northern Pacific at Tacoma, appointed regional signal engineer for the Portland region at Portland, Ore. **D. E. Peterson,** formerly assistant signal engineer Northern Pacific, at St. Paul, appointed regional signal engineer for the Seattle region with headquarters at Seattle, Wash. **E. F. Hutchinson,** former assistant general superintendent of communications for the Burlington, at Chicago, appointed assistant director, communications, for the Chicago and Omaha regions, with headquarters at Chicago. **D. H. Thomsen,** formerly assistant to the signal engineer, CB&Q, at Chicago, appointed regional signal engineer for the Chicago region. **M. R. Roberts,** formerly assistant signal engineer, CB&Q, at Chicago, appointed regional signal engineer for the Omaha, Neb. region. **J. L. Elpel,** formerly assistant signal engineer, Northern Pacific at Livingston, Mont., has been appointed regional signal supervisor for the Billings region and will be headquartered at Livingston. **D. C. Hill,** former superintendent of communications, Northern Pacific, at St. Paul, has been appointed assistant director, communications for the Billings and Minneapolis regions. He will remain headquartered at St. Paul.

CHESAPEAKE & OHIO/BALTIMORE & OHIO: **M. H. Sims** appointed senior circuit engineer signals. **M. S. Ryan** appointed engineer signal reports and agreements. **W. D. Kelley** appointed circuit engineer-signals. **F. T. Branham** appointed junior circuit engineer signals. All men are headquartered at Huntington, West Va. **W. B. Salmons** appointed supervisor of signals at Richmond, Va. **H. Sharp** appointed supervisor of signals, Cincinnati, Ohio.

ELGIN, JOLIET & EASTERN: **William R. Kribs** and **Andrew L. Helgeson** appointed auditors of data processing procedures. **Michael C. Givler** and **Richard G. Terlap** appointed senior auditors of data processing procedures. **John F. Jenco** and **Sylvester Seaborn, Jr.** appointed computer operations supervisors. All men are headquartered at Joliet, Ill.

WESTERN PACIFIC: **Theodore P. Wroblicky,** manager, on-line systems, appointed assistant director of management services. **W. J. Burnside,** project manager, appointed manager of systems development and applications. **F. L. Dunn** appointed manager of systems development and applications. **R. L. Rademacher,** project manager, appointed manager of computer operations.

CHESAPEAKE & OHIO: **S. H. Bostic** appointed supervisor signals, and **C. E. Deane** appointed assistant supervisor signals, at Clifton Forge, Va.

SOUTHERN: **John B. Marbury, Jr.** appointed signal and electrical supervisor, Inman yard, Atlanta. **W. Alton Lee,** appointed signal and electrical construction supervisor, Atlanta. **John E. Peeler,** signal and electrical supervisor at Inman yard, appointed assistant signal and electrical engineer at Atlanta.

LOUISVILLE & NASHVILLE: **L. Stanley Pickett** appointed assistant to manager, management information services. **Mel L. Underhill** and **John L. Hammond** appointed supervisor, systems operation. **Thomas W. Burger** appointed project leader-traffic support, and **Robert J. Williams** appointed project leader-operations support, both in the management information services department.

Suppliers

COPPERWELD STEEL CO.: **William A. Miller** appointed sales representative, Wire and Cable Division, at New York City. He will represent the company in Delaware, Maryland, New Jersey, Pennsylvania, Southeastern New York and part of Virginia.

GENERAL ELECTRIC CO.: **Edwin A. Dumas** named to head microwave field application engineering operations at the telecommunication products department's northeast region in Reston, Va.

GENERAL RAILWAY SIGNAL CO.: **George H. Koester,** senior applications engineer, appointed supervisor of rail and rapid transit systems in the application engineering department.

GRAYBAR ELECTRIC CO., INC.: The following men have been appointed managers: **W. L. Wood** at Des Moines, Ia.; **F. B. James** at Arlington, Tex.; **D. J. Ray** at Costa Mesa, Calif.; **A. G. Breitung,** at Hammond, Ind.; **R. F. Wethern** at Green Bay, Wis.; **J. A. Derque** at Van Nuys, Calif.; **D. L. Spotten** at Santa Barbara, Calif.; **K. L. White** at Tucson, Ariz.; **M. E. Faris** at San Diego, Calif.; **R. B. Reigel** at Wichita, Kan.; **R. G. Baker** at Las Vegas, Nev.; **J. W. Bolt** at Greenville, S.C.; and **H. A. Bowden** at Huntsville, Ala.

The following men have been appointed operating managers: **J. J. Gaps, Jr.,** at Des Moines; **W. P. Chandler** at Arlington; **D. P. Dugle** at Costa Mesa; **J. P. Ballard, Jr.,** at Springfield, Mo.; **P. Lisa** at Newark, N.J.; **E. W. Ballou** at North Brunswick, N.J.; **R. W. Wright, Jr.,** at Shreveport, La.; **K. H. Davidson** at Albuquerque, N.M.; **J. T. Wimprine**

E. F. Hutchinson
Burlington Northern

M. B. Walker
Burlington Northern

C. H. Wesman
Burlington Northern

O. M. Chiesl
Singer Co.

Clarence W. Compher
General Ry Signal

Thomas H. Evans
General Ry Signal

at New Orleans, La.; **F. J. Tiedemann** at Hamden, Conn.; **F. Mossa** at West Hartford, Conn.; and **J. N. Geronimo** at Elmsford, N.Y.

PULSE COMMUNICATIONS INC.: **Preston E. Groome** appointed regional manager serving the New England States, New York, New Jersey and Pennsylvania.

GENERAL ELECTRIC CO.: **Archie E. Warren** appointed central regional sales manager at Columbus, Ohio for telecommunications products department. **R. S. Rothermel** appointed northeast regional manager telecommunications systems sales at Reston, Va. **Robert L. Casselberry** appointed manager of the newly-created new business development operation for the communications systems division at Lynchburg, Va.

GENERAL RAILWAY SIGNAL CO.: **Clarence W. Compher,** sales representative Atlanta, Ga., appointed district manager. **Thomas H. Evans,** sales representative St. Paul, Minn., appointed district manager. **Thomas J. Judge,** sales representative Oakland, Calif., appointed district manager. **S. M. Latone,** sales representative Boston, Mass., appointed district manager. **Fred W. Smallenburg,** sales operations specialist, Rochester, N.Y., appointed district manager St. Louis, Mo.

INTERMODAL TRANSPORTATION SYSTEMS, INC.: **Allen Anderson** appointed regional general manager, railroad services, at Chicago, Ill.

ONAN, Division of Studebaker Corp.: **James C. Hoiby,** vice president-engineering, appointed vice-president advanced design and planning. **Joseph D. Menth,** director of planning, appointed vice president-engineering. **Gene Anderson** appointed zone manager for states of California, Hawaii, Nevada and Arizona, succeeding **Frank Gernand,** retired. **Earl Wollan** appointed zone manager for Iowa, Missouri, Tennessee, Arkansas, Nebraska

(Please turn to page 40)

If you want a tube distributor who knows your business, give it to him.

He's your RCA Industrial Tube Distributor. No.1 in tubes for all communications applications.

What made him No. 1? Emergency service is one reason. It's like money in the bank.

For example:

A tube fails. You're out of replacements. Or maybe you have a few. Too few for comfort. So you call your RCA Industrial Tube Distributor.

He's set up to give you emergency service. Even after he closes his doors at night, chances are he'll be able to open his shop and find the tube you need to keep your line of communications open.

There are more reasons.

Experience. He talks your language, knows your needs. Some of our distributors have been in the communications business for as long as we have—40 years!

Quality. Your RCA Industrial Distributor stocks the finest line of tubes for aviation, rail, mobile and fixed station communications. In power tubes, for example, brand preference studies conducted by leading electronic publications have listed RCA as the first choice of professional designers year after year!

Inventory. The widest. Transmitting tubes, receiving tubes, rectifiers, cathode-ray tubes, light-sensitive tubes, vidicons. Think of his establishment as your tube warehouse. For all practical purposes, that's what it is!

Need more reasons? Call your local RCA Industrial Tube Distributor. For starters, ask him for the new 1970 Guide to RCA Industrial Tube Products, or write: RCA Electronic Components, Commercial Engineering, Dept. E150P, Harrison, N. J. 07029.

RCA

PEOPLE

(*Continued from page 39*)

and Oklahoma. **DeWayne Babb,** service manager, appointed zone manager for Chicago–St. Louis area covering parts of Illinois Missouri and Indiana, succeeding **Richard Nelson,** retired. **Willis E. Erickson,** assistant eastern regional sales manager, appointed service manager. **James K. Duchenes,** assistant sales promotion manager, appointed sales promotion manager.

SINGER CO.: O. M. Chiesl appointed to newly created position of coordinator of advertising and public relations for the metering and controls group. He will continue to serve as manager of advertising and promotion for Vapor Corp.

P. F. Conte
S&C Div., WABCO

H. L. Hathaway
S&C Div., WABCO

SIGNAL & COMMUNICATIONS DIVISION, WABCO: P. F. Conte appointed marketing engineer for railway and industrial markets.

L. K. Hedding
S&C Div., WABCO

D. D. Huffman
S&C Div., WABCO

Thomas J. Judge
General Ry Signal

George H. Koester
General Ry Signal

S. M. Latone
General Ry Signal

Fred W. Smallenburg
General Ry Signal

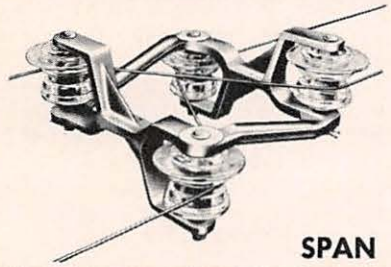
STROMBERG-CARLSON CORP.: **Donald G. Bender,** manager toll-ticketing, appointed market research administrator. **W. O. Myers** appointed manager technical communications, and will be responsible for advertising, sales promotion and publication activities.

WESTINGHOUSE AIR BRAKE CO., Signal and Communications Division: **D. D. Huffman,** section engineer, appointed manager project engineering. **H. L. Hathaway** appointed manager systems planning and analysis. **L. K. Hedding** appointed manager engineering services. **A. J. Carey** appointed section manager, railroad control, project engineering group. **C. W. Gilbert** appointed section manager, systems planning. **Charles H. Mertz,** manager of customer service, Air Brake Division, appointed manager of manufacturing.

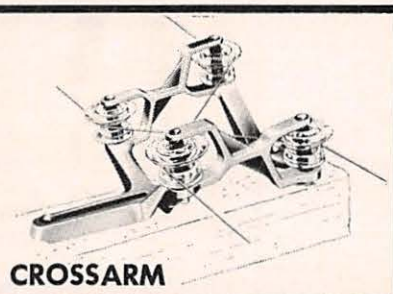
Obituary

WILLARD A. WOOD, senior consulting engineer for Signal & Communications Division of WABCO, died recently in Pittsburgh, Pa.

45 of the 52 Class 1 Railroads in the U.S.A. & Canada Specify & Use CASE TRANSPOSITION BRACKETS



SPAN



CROSSARM

LIGHTWEIGHT • LONG LIFE • LOW COST

Especially Adapted for Carrier Circuit Construction

TRANSANDEAN ASSOCIATES, INC.

303 MAIN STREET, ORANGE, NEW JERSEY

Write for the name of the authorized distributor in your territory.

Circle 14 on reader service card

SPECIAL OFFER ! ! !

2000 MCM Class B Stranding Okolite Insulation—PVC Jacketed 1 KV Cable. Available in 1000 feet lengths. Sample submitted upon request.

ACE WIRE and CABLE CO., INC.
72-01 51 AVE., WOODSIDE, N.Y. 11377

POSITION REQUESTED

Communication/electronic engineer or C&S engineer. 6 years railroad experience. Resume on request. H. Pfeiffer, 52 Scotch Pine Dr., Voorheesville, N.Y. 12186.

ADVERTISER'S INDEX

Ansonia Wire & Cable Co. *(T&T Advertising)* 36-37

Canadian Marconi Co., Telecommunications Division *(Conti Advertising Agency, Inc.)* 3

Copperweld Steel Co. *(The Griswold-Eshleman Co.)* 7

Thomas A. Edison Industries, Primary Battery Division ..... IBC

General Railway Signal Co. *(The Rumrill-Hoyt, Inc.)* 10

Graybar Electric Co., Inc. *(Gaynor & Ducas, Inc.)* 9

Hayes Track Appliance Co. *(The Pattersons, Inc.)* 41

The Kerite Company *(O. S. Tyson & Co.)* 22-23

Lenkurt Electric Co., Inc. *(Hoefer, Dieterich & Brown, Inc.)* 6

The Mid-Control Co. *(Marcus Advertising, Inc.)* 41

National Car Rental Systems, Inc. *(Campbell Mithun, Inc.)* 8

Quindar Electronics, Inc. *(Barbetta/Miller Advertising, Inc.)* 4

RCA Electronic Components, Commercial Engineering Dept. *(Al Paul Lefton Co., Inc.)* 39

Railroad Accessories Corp. *(Faber Advertising, Inc.)* ..... IFC

Servo Corp. of America *(Industrial Marketing)* 12

Stromberg-Carlson *(The Rumrill-Hoyt, Inc.)* 32-33

Transandean Associates, Inc. *(Douglas Brush Advertising Agency)* 40

Western-Cullen Division, Federal Sign & Signal Corp. *(Merrill, McEnroe & Associates, Inc.)* ..... BC

Hand-thrown or remote-controlled

Hayes ALL-STEEL DERAILS

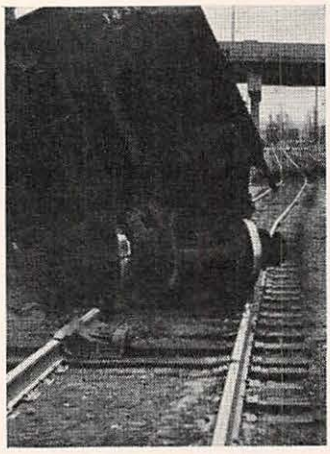
physically protect the main line

Derails or signals? Each has its place: signals are obeyed by men; Hayes Derails are obeyed by equipment.

When signals are not involved, the Hayes Derail alone is competent to keep the main track clear.

In modern signal systems, the Hayes Sliding Derail with DeLectric® Operator under remote control provides complete protection.

The "calculated risk" of omitting derails may be costly. Hayes Derail protection is inexpensive.



© 1968 H.T.A. Co.

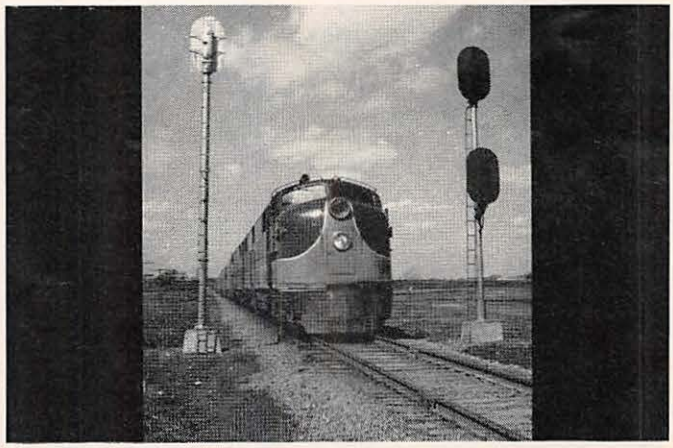
Free leatherette ring-binder catalog of world's most-specified derails, bumping posts and wheel stops (including periodic supplement sheets). Write on letterhead.

Track safety devices that WORK at the job.

Hayes Track Appliance Co.

RICHMOND, INDIANA 47374

Circle 15 on reader service card



America's Railroads Who needs you? We do!

Call us for: Railroad wire and cable
Signal wire and cable
Track wire
Case wire
Communications cable
Distributors: **NIFE** nickel cadmium batteries and battery chargers

Complete Inventories. Fast Delivery.

The Mid-Control Co.

2200 East Devon Avenue
Des Plaines, Illinois 60018 • (312) 297-2071

Circle 16 on reader service card

Editor's Corner

Data pollution is here

With all the talk these days about pollution, I have yet to hear an ecologist mention information or data pollution. This is the kind created by computers, specifically the reams and tons of paper reports printed out at high speeds. Some computer experts measure printouts, not in linear feet of paper, but in stack feet —that is the height of the pile of paper printed with computer-produced data.

Placing the data pollution situation in its proper perspective has been ably performed by Seymour Schweber, president, Schweber Electronics of Westbury, N.Y. In the March 16, 1970 issue of *Electronic News,* Mr. Schweber made the following comments:

DATA INFORMATION POLLUTION

"Don't see the connection? Here it is: *Data only becomes information when it is intelligently analyzed.* With the advent of computers coupled to ultra high-speed printers (1200 lines per minute) we are now facing a new pollution problem: data printouts. We are being inundated by reams and reams of data on paper. A new disease has hit the industry called 'data indigestion.' It seems to be clogging up the lines of creative communications.

"First, let's analyze data. What is it? Data are fragments of facts gathered by people, instruments or machines. Regardless of the method used or the content accumulated, if it is organized, put together attractively, properly presented, it takes on the mystique of truth and objectivity. It is usually judged by its orderliness rather than its meaningfulness, by its clarity rather than its vitality, by its affirmativeness rather than its creativity.

"What are some of the good things about these readouts? It has reduced the drudgery of physical and mechanical work by electrification so that retrieval can be immediate. So far, so good. However, under the older and slower methods people had contact with what they were doing. Now through electronics it is handled remotely and impersonally, so one becomes completely detached from the inputs. Nobody makes errors any more, only machines do! Now let's get back to the data deluge and what it is doing to decision makers. In the presence of computers, using your sense of feel, or smell, or flying by the seat of your pants is absolutely forbidden. Instincts are for animals only. What you need now is data to back up, support, and determine your decisions.

"The problem is that so much data is available to you, from so many sources, that you must hire a group of assistants just to read the stuff. These people in turn interpret the data for you and present their opinions of the facts as they see it. You are now removed from the actual readouts and have to make decisions based on the opinions of the people who read them. You now have to fall back on your own intuitiveness and figure out which of your assistants are right."

NEED TWO OPERATIONAL GROUPS

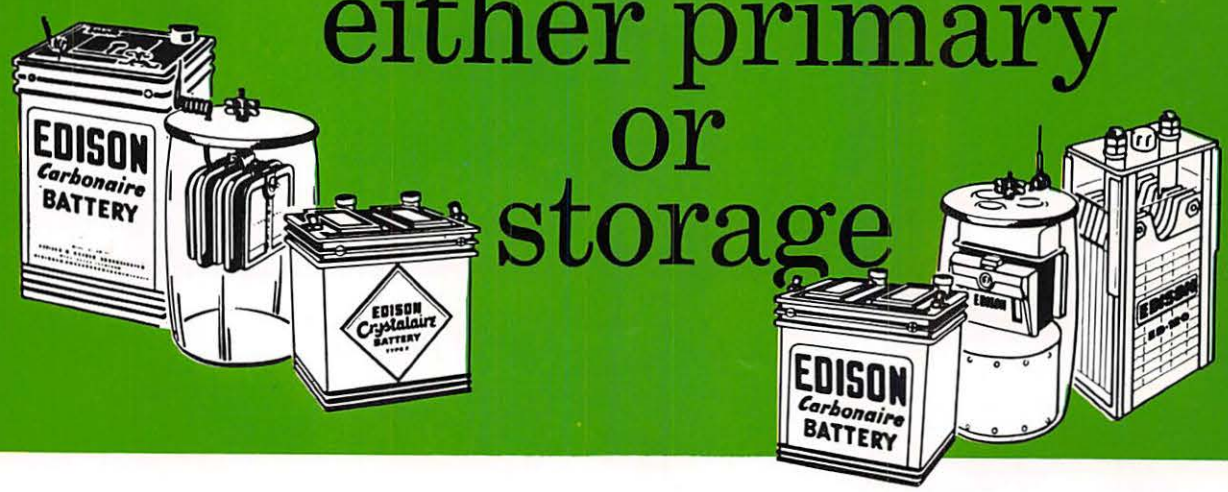
"I think every organization should have two separate operational groups. Let's call one of these 'The Data Collectors,' and the other 'The Sensory Probers'; the former group deals in raw data, the latter group in the behavior behind the data. The chief decision maker should call in each group separately for their opinions, and then, being a non-specialist of broad experience, should in his own mind weigh the presentations and come to his own conclusions.

"Because Americans are so gadget-minded, they become addicted to them, using them as crutches instead of tools. Computers are here to stay—but how to control them rather than be controlled by them, how to distinguish information from data—these are the challenges that confront us."

Although some may think the above quoted remarks contain too much levity, I ask you, who are users of computer-produced data to look around. Do you regularly receive computer printouts, and if so, how many "stack inches" do they measure in a week's time? One solution, suggested by some computer experts, is the proper programming of edit routines so as to reduce the deluge of data to short, meaningful reports. Flagging of exceptions can help.

To reduce the data inundation to a meaningful trickle for human interpretation and handling will require the combined efforts of managers and data processing experts. And it can be done. Many railroads are working on the problem, and in varying degrees are finding practical solutions, but it is a never-ending chore. Meaningful management of data is never easy, and especially so with computers to mass produce it. Southern Railway's approach is clearly outlined in the interview with Jack Jones, vice-president, management information services department, appearing on pages 27-30 of this issue.

When you buy an Edison Battery– either primary or storage



. . . you get regular, prompt and useful field service, at no cost or obligation, which automatically continues as long as our products are working for you.

We believe this service — as volunteered by our representatives or as requested by you — is an important extra to be considered when you are selecting or specifying power sources for your requirements.

You also get all the advantages of using products specifically designed and developed for your needs . . . products that are fully manufactured in America.

MEMBER RPI

THOMAS A. EDISON INDUSTRIES
PRIMARY BATTERY DIVISION • BLOOMFIELD, N. J. 07003

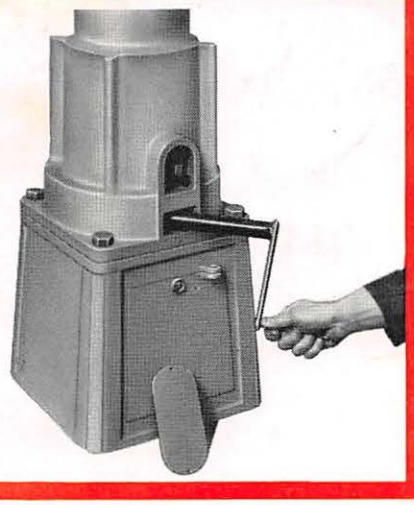
McGRAW EDISON

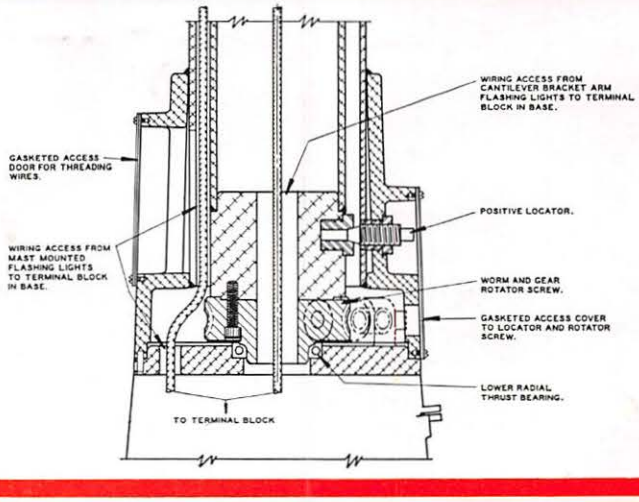
Circle 2 on reader service card

TIME-SAVING, SIMPLIFIED SERVICING

Is Now An Even Bigger Feature With

WESTERN-CULLEN'S NEW ROTATABLE ALUMINUM CANTILEVER TYPE A760




WIRING ACCESS FROM CANTILEVER BRACKET ARM FLASHING LIGHTS TO TERMINAL BLOCK IN BASE.
GASKETED ACCESS DOOR FOR THREADING WIRES.
POSITIVE LOCATOR.
WIRING ACCESS FROM MAST MOUNTED FLASHING LIGHTS TO TERMINAL BLOCK IN BASE.
WORM AND GEAR ROTATOR SCREW.
GASKETED ACCESS COVER TO LOCATOR AND ROTATOR SCREW.
LOWER RADIAL THRUST BEARING.
TO TERMINAL BLOCK

SIMPLY, IT'S A TURN FOR THE BETTER. In servicing, the bracket-arm of the Western-Cullen Rotatable Aluminum Cantilever Type A760 is released and revolved off-the-highway from the base. Not from the top. Both operations are done simply with a crank. Climbing is required only in servicing the lights.*

Then, when servicing is completed, the arm is cranked back to its over-the-highway position. Then locked. All from the ground, at the base.

Of course, being a "pro," you know all the other features of Western-Cullen's Type A760 Cantilever:

• Withstands 100 MPH wind pressure • When bracket arm is off-highway, it sets automatically in a fixed position for servicing • Available with 12, 15 or 20 foot bracket arms, with 17 foot road clearance • Light-in-weight; your shipping cost is less • Obviously, it's easier to install and maintain • Naturally, being aluminum, it requires no painting and is corrosion resistant.

Truly, you're doing yourself a good turn when you choose the new W-C Rotatable Aluminum Cantilever Type A760!

*Aluminum hook-on ladder available

More information?
Write to us for additional data:

WC WESTERN-CULLEN DIVISION

FEDERAL SIGN AND SIGNAL CORPORATION

Call Us "THE FUTURISTS" (It's a Name We Enjoy Living Up To!)

2700 West 36th Place • Chicago, Illinois 60632

Canada: Woodings Canada, Ltd., 5 Place Ville Marie, Montreal 2, Que.

5504

Circle 3 on reader service card